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NASA SBIR Product Catalog 1991



NASA

National Aeronautics and
Space Administration

Small Business Innovation Research Program
Washington, DC 20546

NASA Small Business Innovation Research

Product Catalog 1991

Foreword

Since 1983 the NASA Small Business Innovation Research (SBIR) program has benefitted both the agency and the high technology small business community. By making it possible for more small businesses to participate in NASA's research and development, SBIR provides opportunities for these entrepreneurs to develop products which may also have significant commercial markets. Structured in three phases, the SBIR program uses Phase I to assess the technical feasibility of novel ideas proposed by small companies and Phase II to conduct R&D on the best concepts. Phase III, not funded by SBIR, is the utilization and/or commercialization phase.

This catalog is a partial list of products of NASA SBIR projects that have advanced to some degree into Phase III. While most of the products evolved from work conducted during SBIR Phases I and II, a few advanced to commercial status solely from Phase I activities. The catalog presents information provided to NASA by SBIR contractors who wished to have their products exhibited at Technology 2001, a NASA-sponsored technology transfer conference held in San Jose, California, on December 4, 5, and 6, 1991. Of the 311 SBIR contractors NASA queried, 89 have products included in this catalog.

The catalog presents the product information in the technology areas listed on the table of contents. Within each area, the products are listed in alphabetical order by company name and are given identifying numbers, e.g., A.01. Also included is an alphabetical listing of the companies that have products described in this catalog. This listing cross-references the product list and provides information on the business activity of each firm. In addition, there are three indexes, one a list of firms by states, one that lists the products according to NASA Centers that managed the SBIR projects, and one that lists the products by the relevant Technical Topics utilized in NASA's annual program solicitation under which each SBIR project was selected. A NASA SBIR document, *Composite List of Projects, 1983 to 1989*, includes a similar cross-reference of all NASA SBIR projects. It and other documents describing the contents of the NASA SBIR Program are available upon request to the NASA SBIR Office, Code CR, Washington, DC 20546.

One major national objective for the SBIR Program is broad commercial applications for the results of R&D sponsored by the Federal government and performed by small businesses. Our hope is that this catalog will stimulate the interest of potential customers for the products listed and that it will encourage contacts with the SBIR participants whose research results have already borne fruit.

Harry W. Johnson
Director, Small Business Innovation Research

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Prepared for the Small Business Innovation Research Office, Office of Commercial Programs, National Aeronautics and Space Administration, by J. A. Gilman, J.B. Paige and F. C. Schwenk of Futron, Inc., Bethesda, Maryland.

PRODUCTS

This section describes products that were derived from NASA SBIR contracts. The products are listed according to the technical areas used by the Small Business Administration in its reporting on the SBIR programs of all participating agencies. In addition to a description of the products, the names and telephone numbers of persons to contact for more information are provided. The SBIR project to which each product relates is identified by the NASA contract number, the responsible NASA Center, the year (PY) in which the Phase I proposal was submitted, and the relevant Technical Topic in NASA's annual program solicitation.

A: Computer and Communication Systems

A.01

QASE@RT

Firm: Advanced Systems Technologies, Inc.

QASE@RT supports system and software engineers by evaluating responsiveness and reliability of computer systems designs (software, hardware, and data). It combines and enhances the features of traditional CASE tools, performance modeling tools, and simulation languages. QASE@RT gives the user both analytic and simulation models to assess the performance effects of different hardware and software designs. The analytical models can be used to rapidly evaluate many design alternatives. The simulation models automatically build from a common system description to investigative system behavior in detail. QASE@RT is an ideal tool for designing real-time and distributed systems.

Applications: Computer system designs where performance and reliability are an issue. Examples include: air traffic control, C³I, embedded systems, on-line and distributed systems.

Contact: David Flanagan
303-790-4242

Related SBIR Contracts:

NAS7-995 JPL PY 1985 Topic 06
"Integrated Modeling Tool for Performance Engineering of Complex Computer Systems"

A.02

Intelligent Computational Resource Management System

Firm: ISX Corporation

The Intelligent Computational Resource Management System (ICRM) is a resource management system and technology for supporting resource usage by advanced applications in a distributed computing environment.

Applications: Management of supercomputing facilities, intelligent management of distributed computers, distributed intelligent network systems.

Contact: Scott Fouse
818-706-2020

Related SBIR Contracts:

NAS2-13027 ARC PY 1987 Topic 06
"Distributed Information Systems: The Intelligent Computational Resource Manager"

A.03

Spacecraft Supercomputer

Firm: Omitron, Inc.

The Spacecraft Supercomputer is based on modular parallel processing technology and is available in Rad-Hard Class-S qualification. The NASA-funded SBIR Phase-I project is based on Omitron's existing parallel-processor testbed. The technology is directly applicable to use on board spacecraft as a result of an Army-funded development effort for space-rating of components. The goal of this project was to define an architecture having an order of magnitude performance increase over existing onboard computing resources; however, it has been shown that improvements of several orders of magnitude are achievable. With scalable processor and communication resources, the hardware can be matched to the problem domain while retaining redundancy and reprogrammability. Scalable parallel processing is applicable to a large set of onboard tasks now and in the immediate future. It provides a capability to generate and distribute data products rapidly that cannot otherwise be done.

Applications: Although focussed toward flight systems, the parallel supercomputer can provide a low-cost approach for any ground-based, computationally intensive task. The unit is programmed in the "C" language.

Contact: Frederick J. Hawkins
301-474-1700

Related SBIR Contract(s):

NAS5-31409 GSFC PY 1990 Topic 06
"Spacecraft Supercomputer"

A.04

Magnetic Bearings for High-Performance Optical-Disk Buffer

Firm: SatCon Technology Corporation

This product applies linear magnetic bearing technology to the suspension of the translator head of an optical disk data storage device. The magnetic bearing control loops perform well, achieving 100 Hz nominal bandwidth with phase margins between 37 and 65 degrees. The worst-case position resolution is 0.02 μ in the displacement loops and 1 μ rad in the rotation loops. The system is very robust to shock disturbances, recovering smoothly even when collisions occur between the translator and frame. The unique start-up/shut-down circuit has proven very effective.

Applications: Optical disks, Michaelson Interferometers, cryogenic temperature optical movements, chip processing.

Contact: Richard L. Hockney
617-661-0540

Related SBIR Contracts:

NAS5-30309 GSFC PY 1986 Topic 08
"Magnetic Bearings for a High Performance Optical Disk Buffer"

A.05

Program CC, Version 4

Firm: Systems Technology, Inc.

Program CC is a computer-aided control-system design program that implements a broad range of classical and modern methods. The latest version includes singular value MIMO robustness methods and H_{∞} optimal control features based on developments in STI SBIR projects.

Applications: Aerospace flight control systems (Pegasus, C-17); tracking antennas/telescopes (Keck telescope); computer disk drives, servo actuators, ground vehicles, chemical process control.

Contact: Jun Taira
213-679-2281

Related SBIR Contracts:

NAS1-17987 LaRC PY 1983 Topic 03
"Advanced Piloted Aircraft Flight Control System Design Methodology"

A.06

Digital Storage Device Prototype

Firm: TiNi Alloy Company

The product is a prototype of a mass storage medium which is written and read optically, is

physically non-volatile and suitable for archival storage, and is accessed with modified optical-scanning machinery. This is accomplished through mechanical movement of reflective domains, each on the order of a few microns in width, by means of shape memory film microactuators.

Applications: Data storage and retrieval.

Contact: A. David Johnson
510-658-3172

Related SBIR Contracts:

NAS2-13113 ARC PY 1987 Topic 06
"Digital Storage Device Using Thin-Film Shape-Memory Alloy"

B: Information Processing and AI

B.01

Neural Net Toolbox

Firm: Accurate Automation Corporation

The neural net toolbox is designed to be used with IRIX (UNIX) systems running on a Silicon Graphics high-performance, three-dimensional graphics superworkstation. This consists of a library of neural network algorithms that can be used for applications. Accurate Automation has developed a neurocontroller for robotic and telerobotic control using a unique, three-tier, decentralized controller operating neural networks. This controller is used for neuro-control movement training, sensor data association, task improvement and multi-joint control.

Applications: The neurocontroller is designed to improve robotic control. The neural net toolbox is designed to assist users of Silicon Graphics workstations to use neural networks in their applications.

Contact: Robert M. Pap
615-622-4642

Related SBIR Contracts:

NAS8-38967 MSFC PY 1989 Topic 05
"Advanced Telerobotic Concepts Using Neural Networks"

B.02

SDL CASE Tool

Firm: Charles River Analytics, Inc.

SDL is a computer aided software engineering (CASE) tool for embedding system knowledge into applications. SDL is an object-oriented shell supporting topological, rule-based, and procedural programming paradigms. SDL has an X-Windows user interface supporting interactive development and compilation into Ada source code.

Applications: Embedded systems, real-time expert systems, monitoring and diagnosis, intelligent systems, decision aids, real-time simulation, flight simulators, vehicle health monitoring.

Contact: J. Leslie Walker
617-491-3474

Related SBIR Contracts:
NAS2-13014 ARC PY 1987 Topic 03
"Expert Systems for Real-Time Monitoring and Fault Diagnosis"

B.03

MetaData

Firm: I-Kinetics, Inc.

This product is the first object-oriented tool for large-system data-specification management. MetaData is a complete, rapid application and development environment for creating and managing data specifications shared by distributed system applications. Data interfaces between different applications typically account for 50 to 80 percent of the code in a systems integration project. MetaData sharply reduces this major lifecycle cost by managing data specifications and automatically generating data interfaces for the developer. It is ideal for maintaining formal specification integrity among the various modules and project teams of a large system. MetaData uses an object-oriented model for describing and manipulating complex data exchanged between networked applications. Applications can be integrated using either dynamic or static data specifications. Static specification supports high-performance compile-time optimization. Dynamic specification allows creation of new types of complex data during runtime. MetaData's runtime services bear the full burden of updating changed specifications shared among networked applications. With either method, MetaData manages the tedious and error-prone packing of data into, and unpacking of data from, files or network packets. MetaData is compatible with any network transport or interprocess communication service that can transmit byte buffers. Objects can be passed to a high-level service, such as RPC or Sunsoft's ToolTalk™, or to lower-level services such as TCP/IP, SNA, or Novell IPX for transport over the network. MetaData for C development is available now for Sun/Unix, NeXT/Unix and PC/DOS platforms. MetaData for Common Lisp is available for all Franz Lisp platforms and the Apple Macintosh II family.

Applications: CAD/CAM tool integration; distributed trading systems; distributed information systems for operations support.

Contact: Bruce H. Cottman
617-661-8181

Related SBIR Contracts:
NAS9-18487 JSC PY 1990 Topic 05
"MetaAgents: A Framework for Intelligent Distributed Systems"

B.04

FDP 3100 Frequency Domain Processor

Firm: Macrodyne, Inc.

The FDP 3100 Frequency Domain Processor is a signal processor used in laser Doppler velocimetry techniques. Using high-speed digital technology, the FDP 3100 provides the user enhanced performance in complex flow fields associated with very low signal-to-noise regimes in boundary layer studies. Major improvements in signal detection plus a significant increase in measurement accuracy provide the experimenter an eight-fold increase in signals over that of present technology. An improved operating efficiency in test cells or other applications offers the user a tangible return.

Applications: The primary uses of the FDP 3100 are in turbomachinery, wind tunnels, combustion engines, propellers, water turbines, channel flow, pumps, blood flow, crystal growth. As an example, LDV techniques have been used extensively to study the mechanical structure of jet wings in wind tunnels by mapping the flow field in proximity to the wing.

Contact: Clifford J. Jurus
518-383-3800

Related SBIR Contracts:
NAS1-18661 LaRC PY 1986 Topic 08
"Frequency Domain Laser-Velocimeter Signal Processor"

B.05

Neural Networks for Fault Monitoring

Firm: Netrologic, Inc.

The Neural Network for Fault Monitoring is capable of integrating multiple time-series in real time to determine fault conditions for rocket engines or machine tools.

Applications: Fault diagnosis and performance monitoring.

Contact: Daniel R. Greenwood
619-587-0970

Related SBIR Contracts:
NAS9-17995 JSC PY 1986 Topic 06
"Space Transportation Analysis and Intelligent Space Systems"

B.06

Sentinel

Firm: Omitron, Inc.

Sentinel evolved from knowledge-based systems technology developed for monitoring NASA spacecraft. Sentinel includes a concept-oriented knowledge-base, a configuration software system architecture, and interactive tools for generating process specifications in engineering terms. Sentinel helps the user generate a process specification to tailor one or more custom "expert" application programs. Sentinel can generate simple PC-based programs to monitor a "what if" process and can configure multiple programs to be hosted on networked VAXs to monitor a production process in real time.

Applications: Industrial process control and engineering simulations.

Contact: Craig M. Bearer
301-474-1700

Related SBIR Contracts:

NAS5-30637 GSFC PY 1987 Topic 07
"A Concept-Oriented, Distributed, Expert System for Spacecraft Control"

B.07

InQuisiX

Firm: Software Productivity Solutions, Inc.

InQuisiX is a highly adaptable classification and search engine that, when integrated in a software development environment, is an advanced software-reuse library system. An InQuisiX reuse library system with its set of cooperating tools supports a software-development process based on reusing software assets instead of development from scratch. InQuisiX provides high-performance classification, cataloging, searching, browsing, retrieval, and synthesis capabilities that form the foundation for comprehensive automation reuse. The InQuisiX capabilities are adaptable and extensible to support an organization's unique development process. The product includes a set of open interfaces to promote integration into the customer's software development environment.

Applications: InQuisiX may be applied to the development of any software application, independent of language. Because InQuisiX is a general-purpose information-retrieval system, it may be applied to enable reuse of software, architectures, designs, tests, documents, or any other data.

Contact: Edward R. Comer
407-984-3370

Related SBIR Contracts:

NAS1-18663 LaRC PY 1986 Topic 06
"Reliable, Knowledge-Based Reusable Software Synthesis System"

B.08

SOCIAL

Firm: Symbiotics, Inc.

SOCIAL extends MetaCourier with a library of predefined building blocks that are specialized for particular integration and coordination tasks. For example, SOCIAL gateways provide a uniform, high-level model for integrating both custom programs and applications implemented with standard DBMSs, 4GLs, CASE tools, and AI shells. SOCIAL managers provide non-intrusive, distributed control models. Managers function as intermediaries that route task requests and results among applications, eliminating the need for "hardwired" direct connections. Scripting tools enable complex sequences of distributed activities to be executed automatically with a single command. NASA is using SOCIAL to unify applications that will automate critical launch-operation support functions for the Space Shuttle fleet, such as system monitoring, fault isolation, and management. SOCIAL will connect and manage these applications non-intrusively, promoting cooperation and synergy through the sharing of information and complementary problem-solving skills.

Applications: Together with MetaCourier, SOCIAL simplifies development and maintenance of complex distributed systems. Application domains include distributed decision support (e.g., planning and scheduling), concurrent engineering, office automation, and automated operational support of complex systems (e.g., computer, communication, power, or manufacturing-process control networks).

Contact: Richard M. Adler
617-876-3633

Related SBIR Contracts:

NAS10-11606 KSC PY 1987 Topic 06
"A Development Framework for Distributed Artificial Intelligence"

B.09

VPLOT3D

Firm: ViGYAN, Inc.

VPLOT3D is an interactive, menu-driven graphics program for interpretation and display of fluid dynamic data on unstructured (tetrahedral) grids. VPLOT3D uses the full graphics capabilities of an IRIS workstation and guides the user through pop-up menus with a variety of options. VPLOT3D has options for line and Gouraud-shaded contour

plots, velocity vectors, particle traces, oil flow traces, and interactive display manipulation. Dynamic memory allocation eliminates the need to compile frequently.

Applications: Computational fluid dynamics, aircraft design, automobile design.

Contact: Paresh Parikh
804-865-1400

Related SBIR Contracts:
NAS1-18670 LaRC PY 1986 Topic 02
"Generation of Unstructured Grids in Three-Dimensions"

B.10

VGRID3D

Firm: **VIGYAN, Inc.**

VGRID3D is an interactive program for the generation of three-dimensional, unstructured grids over complex configurations. The user has options for interactively generating, visualizing, and modifying the surface grid made up of triangles. The field grid is then generated using the "advancing-front" technique. Options are available for restarting a partially completed grid, local remeshing, and grid quality evaluation and smoothing. Interactive pre-processor programs to prepare input to VGRID3D are also available.

Applications: Computational fluid dynamics, aircraft design, automobile design.

Contact: Shahyar Pirzadeh
804-865-1400

Related SBIR Contracts:
NAS1-18670 LaRC PY 1986 Topic 02
"Generation of Unstructured Grids in Three-Dimensions"

C: Robotics and Automation

C.01

Reactive Planning for EVA retriever

Firm: **Advanced Decision Systems**

The Reactive Planner implements technology for reactive execution of robotic tasks. Reactive execution is the ability to adapt to an uncooperative environment while following a plan. The plan representation language and execution system developed for this project supplies five capabilities essential to reactive response. This system is able to: react to unexpected events, act to acquire knowledge, act on beliefs, react to internal states (as well as external conditions), and act on predictions about the future. This reactive planner was developed for the Extra Vehicular Activity

Retriever (EVAR), a robot whose purpose is to retrieve tools, or astronauts, that become detached from the Space Station.

Applications: Planning and control of robotic devices in uncertain or dynamic environments.

Contact: David Gaw
415-960-7557

Related SBIR Contracts:
NAS9-18162 JSC PY 1987 Topic 05
"Architectures for Semi-Autonomous Planning"

C.02

Robotic Tactile Sensor System

Firm: **Bonneville Scientific, Inc.**

Bonneville Scientific has successfully developed and patented a superior technology that can mimic the human sense of touch. This technology is the only one in existence today sufficiently rugged and reliable for use in robotic tactile sensing in factory automation applications. A tactile sensor is applied to the gripper of a robot to enable the robot to "feel" the object it is touching. The Bonneville tactile sensor is a thin device that can replace the existing rubber pad on most robot grippers. This enables the robot to discern the shape of the object it is touching, and to control the forces it is placing on the object, thus significantly increasing the robot's capability.

Applications: Targeted applications for Bonneville's unique sensing technology include tactile sensing, force-torque sensing, foot-force mapping, gait analysis, and programmable limit switches.

Contact: Josephine M. Grahm
801-359-0402

Related SBIR Contracts:
NAS1-17586 LaRC PY 1983 Topic 05
"Six Component Robotic Force/Torque Sensor"

C.03

Cybernet Force-Reflecting Handcontroller

Firm: **Cybernet Systems Corporation**

This product is a six-axis force-reflecting universal master that provides user inputs in x, y, z, pitch, roll, and yaw. Additional thumb switches and LVDT trigger provide inputs for control cueing, indexing, and end-effector control. The master is supplied with a controller and C-based software for easy interfacing to a variety of industrial and specialty robots (as slaves).

Applications: Space telerobotics, hazardous or underwater robotics, interaction with virtual environments.

Contact: Heidi N. Jacobus
313-668-2567

Related SBIR Contracts:
NAS9-18351 JSC PY 1988 Topic 09
"A Compact Six-Degree-of-Freedom Force Reflecting Hand Controller with Cueing of Modes"

C.04

CyberImage

Firm: **Cybernet Systems Corporation**

A low-cost, general-purpose machine-vision and image-processing system and environment. Provides most basic image-processing and enhancement facilities. Interfaces to a variety of image-input devices and image file formats, display, printing, and image-editing facilities, and an extensible Pascal-like user programming facility with enhancements for operator overloading, object segmentation, model-based object matching, and nearest-neighbor matching. Users can incorporate compiled functions and can extend interfaces and communications facilities. System supports Apple Quick Time, and System 7.0. Interfaces with CAD Interchange data are planned for 1992.

Applications: Space telerobotics, hazardous or underwater robotics, industrial robotics, mobile robot navigation, image processing, video/photo editing.

Contact: Heidi N. Jacobus
313-668-2567

Related SBIR Contracts:
NAS7-1116 JPL PY 1990 Topic 05
"Intelligent Robot/Sensor Operations Planning Systems"

C.05

Holotrack

Firm: **Cybernet Systems Corporation**

Holotrack is a holographic-based, three-dimensional targeting system that uses a conventional, video-based imaging system to locate objects in three space. Three-dimensional targets are captured in holographic images. The flat hologram of the three-dimensional target can be mounted on an object so as to provide an easily identifiable feature for machine-vision recognition and pose determination.

Applications: Space telerobotics, hazardous or underwater robotics, industrial robotics, mobile robot navigation.

Contact: Heidi N. Jacobus
313-668-2567

Related SBIR Contracts:
NAS8-38916 MSFC PY 1990 Topic 05
"Robotic Guidance Systems Using Specialized and Generalized Targets"

C.06

Serpentine Truss Robot

Firm: **Foster-Miller, Inc.**

The self-contained, deployable serpentine truss (SCDST) is a highly articulated robot designed to be operated in tightly constrained environments. The device consists of an innovative articulated-truss structure, a deployable mechanism, and a distributed microprocessor-network system controller. No other robot has yet been designed that has reach capability in excess of 6 m; a deployment mechanism that facilitates launching the device along a circuitous trajectory, thus snaking around obstacles; and a controller performing the necessary transformations and feedback functions for over 20 actuators in real time.

Applications: Pre-launch inspection and preparation of Space Shuttle payloads. Inspection and light tactile tasks in cramped and hazardous environments.

Contact: Richard M. Wiesman
617-890-3200

Related SBIR Contracts:
NAS10-11794 KSC PY 1989 Topic 05
"Self-Contained Deployable Serpentine Truss (SCDST) for Pre-Launch Access of Space Shuttle Orbiter Payloads"

C.07

RT/Expert

Firm: **Integrated Systems, Inc.**

RT/Expert is a knowledge-based expert system that automates and accelerates the development of real-time systems. The RT/Expert Module is integrated into ISI CAE/CASE tools, providing an integrated environment for rule-based logic and complex numerical computation. Decision structures built with RT/Expert can be automatically converted into real-time C, Ada or Fortran code.

Applications: Real-time controls or supervisory control, monitoring and diagnostics, and autonomous control tuning.

Related SBIR Contracts:
NAS2-12738 ARC PY 1986 Topic 03
"Automation Tools for Self-Repairing Flight Control Systems"

C.08

Ground Vehicle Manager's Associate

Firm: ISX Corporation

The Ground Vehicle Manager's Associate is a mixed-initiative, human-computer problem-solving system based on deep expert-assistant knowledge of the domain and about how to aid the user performing tasks. The NASA application is control and management of micro-robots on the lunar surface.

Applications: Management of multiple semi-autonomous vehicles performing a variety of missions.

Contact: Phil Dodson
818-706-2020

Related SBIR Contracts:

NAS2-13373 ARC PY 1989 Topic 06
"Knowledge-Based Decision Support for Space System Engineering Managers"

C.09

Motion Planning Algorithms for Dexterous Manipulator

Firm: Odetics, Inc.

Motion planning algorithms generate safe trajectories around obstacles in the manipulator workspace. The manipulator's redundant degree of freedom is used to avoid collisions with obstacles. The workspace model is sensor-acquired or CAD-based. The algorithms are designed to run in real time.

Applications: Material handling, remote manipulation, autonomous navigation in cluttered and/or unstructured environments.

Contact: Nigel King
714-758-0300

Related SBIR Contracts:

NAS7-1055 JPL PY 1988 Topic 05
"End Point Collision Avoidance Path Planner for Redundant Degree of Freedom Manipulators"

C.10

Odetics Dexterous Manipulator

Firm: Odetics, Inc.

The Odetics Dexterous Manipulator is a seven-degree-of-freedom robot manipulator. It is electrically powered and has a modular design. The manipulator has a high payload-to-weight ratio (50 lb payload, 150 lb weight). Each of the seven joints incorporates a unique drivetrain design which provides zero-backlash operation, is insensitive to wear, and is single-fault tolerant to motor

or servo amplifier failure. The sensing system provides position, velocity, motor winding temperature, and torque measurements for each joint, and is also single-fault tolerant. The control system provides dexterous motion by controlling the end-point motion and manipulator pose simultaneously.

Applications: The manipulator is targeted to address applications requiring high dexterity, as well as the strength of a hydraulic manipulator, for which hydraulic systems are impractical or impossible. Examples include satellite servicing and truss assembly in space, as well as hazardous material handling in unstructured terrestrial environments. The manipulator's modularity will support a wide range of applications that require fewer than seven degrees of freedom. Batch-oriented, flexible manufacturing systems will benefit from the simple reconfiguration capability.

Contact: Sam Harris
714-758-0100

Related SBIR Contracts:

NAS7-1062 JPL PY 1987 Topic 05
"Control Algorithm for a Redundant Degree of Freedom Manipulator"

C.11

Omni-Wrist

Firm: Ross-Hime Designs, Inc.

The Omni-Wrist is a three-axis, robot-wrist mechanism featuring highly flexible, singularity-free motion. A unique, 180 degree pitch and yaw, and 360 degree continuous roll is produced. Modular in design, the three wrist motors are located in its base. An internal cable-routing passage is provided for end-effectors. High precision and a 25-pound load capacity are also featured.

Applications: Aerospace, military, undersea, ultrasonic testing, spray finishing, and welding.

Contact: Mark Elling Roshelm
612-379-3808

Related SBIR Contracts:

NAS1-18673 LaRC PY 1986 Topic 05
"Computer Controlled Telerobot Wrist Module"

C.12

Dual-Axis, Digital Servo Controller

Firm: The NAVTROL Company, Inc.

The dual-axis, digital servo controller (DDSC) is a highly capable, compact, lightweight, low-power controller. Receiving analog or discrete sensor signals through extensive I/O, it generates controlled current, 0 to 8 amperes, by means of pulse-

width modulation (PWM) for brush or brushless type DC motors to provide independent force, velocity, or position control for two loops. Incremental or absolute angle encoders, resolvers, potentiometers, or even motor commutation signals can provide position and/or velocity measurements. One to seven controllers can operate autonomously or collectively, exchanging data and commands with a supervisory controller over a single, differential, high-speed (5 MHz) serial interface. The DDSC, only 4.5" x 5.5" inches in size, requires only dc motor voltage (28 Vdc) for power and consumes only 3.7 watts. Sophisticated estimation, control, and transformation algorithms provide smooth, precise, and versatile tracking and control.

Applications: Pointing systems, robotic systems, and other servo-control applications for commercial, space, and military utilization.

Contact: Richard J. Brown
214-234-3319

Related SBIR Contracts:
NAS5-29437 GSFC PY 1984 Topic 14
"Low-Power, Digital Controller for Laser Communications"

NAS5-30633 GSFC PY 1987 Topic 05
"A Telerobotic Digital Controller System"

D: Signal and Image Processing

D.01

Interferometric Satellite Tracking System

Firm: **Interferometrics, Inc.**

The Interferometric satellite tracking system uses the techniques of very long baseline interferometry to track satellites with expected accuracies that are an order of magnitude greater than present systems. Unlike existing tracking techniques, this system is completely passive and uses normal satellite traffic or transponder noise to perform the correlations. The system consists of three field stations and a central processing microcomputer. Each field station includes a 1.8 meter antenna, downconverter, data buffers, and control computer. The field stations transmit data to and receive schedules from the central processing site via dial-up phone lines. The tracking system, which is presently undergoing deployment in the southwestern U.S. within the K-band downlink beam of TDRS-E, is also capable of tracking Ku-band domestic satellites in addition to the TDRS. Additional RF front ends can be employed to track C-band satellites as well.

Applications: Passive satellite tracking.

Contact: E. James Wadlak
703-790-8500

Related SBIR Contracts:
NAS5-30313 GSFC PY 1986 Topic 07
"A Tracking System for the Tracking and Data Relay Satellite"

D.02

Digital Image Profiler

Firm: **Laser Power Corporation**

The Digital Image Profiler is designed to detect faint optical sources in the presence of bright optical sources. An image of a known or suspected optical binary is scanned across a linear array of slit-like fiber bundles. Each of the resultant one-dimensional image profiles is processed by specially designed computer-controlled electronics. Post-processing techniques reveal the faint source.

Applications: Verification of suspected faint stellar companions.

Contact: Graham Flint
619-755-0700

Related SBIR Contracts:
NAS7-1103 JPL PY 1988 Topic 08
"Digital Image Profilers for Detecting Faint Sources Which Have Bright Companions"

D.03

Real-Time Integrated GPS/INS Navigation and Attitude Determination Software

Firm: **Mayflower Communications Company, Inc.**

Mayflower has developed real-time Ada software that implements a multi-mode, reconfigurable Kalman filter specifically designed for use in attitude determination onboard spacecraft. This GPS/INS attitude determination software provides a low-cost alternative to star-trackers and other high-cost attitude systems. This software can be used in simulation or in a hard real-time system, and supports run-time modification of the stated error model definition. The simulation version runs on PC compatibles and DEC VAX systems. The real-time system runs on Intel 386/486 systems.

Applications: Kalman filter development for space, avionics, and military systems. This software can support simulations during development, or it can be used in real-time applications.

Contact: Triveni Upadhyay or Steve Cotterill
617-942-2666

Related SBIR Contracts:

NAS8-38479 MSFC PY 1988 Topic 09
**"Autonomous, Integrated GPS/INS Navigation
Experiment for STV"**

D.04

Adaptive Imager

Firm: **Odetics, Inc.**

This prototype imager performs edge enhancement at RS-170 video rates (30 frames/sec). It is a very-high-speed, non-linear, large-area convolver that has the ability to enhance edges in the dark areas of a scene as well as the bright areas in the same scene. It produces a visually-enhanced output image that is based on an algorithm patterned after human vision.

Applications: Computer vision and image-edge enhancement of objects in low-light environments. Provides a means for measuring reflectance changes independent of scene illumination.

Contact: George B. Westrom
714-774-5000

Related SBIR Contracts:

NAS1-18468 LaRC PY 1985 Topic 07
"Adaptive Focal Plane Processor for Image Enhancement"

E: Microelectronics

E.01

ARACOR VLSI Qualification Test System

Firm: **Advanced Research and Applications Corporation**

The ARACOR VLSI Qualification Test System (QTS) will provide fully-automated certification testing of BLSI components for space programs and other high reliability applications. The basic hardware consists of an input tray, an x-ray radiation source, an electrical stress/test station, and an annealing station. A pick-and-place robotic system moves the parts between stations. Special chip carriers maintain appropriate bias conditions on the parts in transit. A computer controls all system functions and provides menus to set test parameters. System activity and test status are displayed in real time. Application software (which requires an HP4145B or HP4142B) includes total-dose harness assurance and channel hot-electron device lifetime modules.

Applications: The ARACOR VLSI QTS is being developed to support a new methodology to qualify VLSI circuits for high-reliability applications. In this new procurement scheme, each vendor incorporates a standard technology characterization

vehicle (TCV) as a drop-in on its product wafers. After processing, the TCVs are pulled and characterized on the QTS using standard test procedures. If the TCVs pass the tests, all associated parts that meet performance requirements are qualified. This new approach significantly reduces the cost of procuring qualified components and is ideally suited to situations in which a variety of part types must be procured from multiple vendors in small quantities.

Contact: Jim Wiedeman or Jim Stanley
408-733-7780

Related SBIR Contracts:

NAS7-1083 JPL PY 1989 Topic 13
"Automated Radiation/Reliability VLSI Qualification"

E.02

Indium-Phosphide Epitaxial Wafers and Solar Cells

Firm: **Spire Corporation, Electronic Materials Division**

Spire supplies both Indium-phosphide epitaxial wafers and solar cells. The epitaxial wafers are two inches in diameter and can have both P and N doping. Indium-phosphide solar cells are 20 percent efficient and hardened against high-energy radiation damage.

Applications: Indium-phosphide semiconductor devices such as Gunn diodes, solar cells, and opto-electronic devices.

Contact: Kurt Linden
617-275-6000

Related SBIR Contracts:

NAS3-24857 LeRC PY 1984 Topic 10
"High-Efficiency, Radiation-Resistant, Indium-Phosphide Solar Cells"

E.03

III-V Compound Epi-Wafers

Firm: **Spire Corporation, Electronic Materials Division**

Spire supplies MOCVD-grown GaAs/AlGaAs epitaxial wafers for use in DH and quantum-well diode lasers. Wafers can be grown with a two- to three-inch diameter and uniformity of ± 3 percent. Thinned and processed wafers are also available. The company welcomes inquiries for processed, quantum-well laser-array bars ready for mounting. Customers are provided complete analysis results including photoluminescence, IR reflectance, and polaron profile with each lot to assure compliance with specifications.

Applications: Semiconductor diode lasers, quantum-well devices, Bragg reflector structures, optical waveguides, opto-electronic devices.

Contact: Kurt Linden
617-275-6000

Related SBIR Contracts:

NAS1-18660 LaRC PY 1986 Topic 08
"Low-Cost AlGaAs Laser Arrays for Solid State Laser Pumps"

F: Electronic Devices and Equipment

F.01

Auto-Cal Detector Calibration System

Firm: Cambridge Research and Instrumentation, Inc.

The Auto-Cal Detector Calibration System has been developed to provide detectors with an absolute accuracy of 0.02 percent. It utilizes a frequency-doubled argon ion laser operating at 257 nanometers as the ultraviolet light source which is stabilized to 0.05 percent by a laser intensity stabilizer. The laser beam is controlled by a series of beam-steering optics that direct the beam to either the detector (e.g. spectrometer) or the LaseRad cryogenic radiometer. LaseRad is an electrical substitution radiometer with improved performance due to cryogenic cooling of the absorptive cavity to 4.2 K, resulting in an absolute accuracy of 0.02 percent. Design innovations incorporated in the LaseRad include: a side-viewing, highly-absorptive cavity, a compact dewar, and computer control. The dewar has a hold time of ≈ 12 hours. The cavity interior is coated with specular polyurethane carbon black paint allowing operation from the UV to the far IR (10.6 μm). Its temperature is actively controlled using a thin-film heater and monitored by a sensitive digital temperature controller. At 4.2 K, the thermal properties of the materials used in the receiver cavity undergo dramatic changes. The specific heat of copper decreases by three orders of magnitude, and its thermal conductivity increases by at least a factor of three. The thermometers and the heater are attached with superconducting niobium titanium wire to eliminate ohmic losses in the heater power measurement and to minimize extraneous heat fluxes from the cavity. These effects increase the responsivity and the sensitivity, and shorten the time constant of the system. The LaseRad system is operated by an AT-type computer using menu-driven software.

Applications: To date, cryogenic radiometers have been confined to national standards laboratories due to their cost and the need for special facilities. With its compact dewar, computer con-

trol, and low cost, the Auto-Cal System gives corporate metrologists the ability to produce better quality products by maintaining an absolute reference standard in their own facility.

Contact: Clifford Hoyt
617-491-2627

Related SBIR Contracts:

NAS5-30631 GSFC PY 1987 Topic 08
"An Automated Characterization and Calibration of Ultraviolet Spectrophotometers Using Intensity-Stabilized Lasers"

F.02

Cryogenic TIA Input Stage

Firm: Infrared Laboratories, Inc.

The TIA (trans-impedance amplifier) module consists of a hybrid circuit containing a monolithic, dual silicon JFET. The JFET is carefully selected for low noise and close matching of dc characteristics. The result is a balanced JFET source follower that provides extremely high performance as a low noise, trans-impedance amplifier input stage. Tests show that for feedback resistors up to 1×10^{11} ohms the noise spectrum is dominated by Johnson noise at temperatures down to 4 K. Input capacitance is less than 4 pf.

Applications: Low-noise cryogenic amplifier for real-time use with infrared detectors (bolometers, photodetectors, and detectors made of extrinsic silicon or indium antimonide). Well suited for both laboratory and space-flight applications.

Contact: Eric Low
602-622-7074

Related SBIR Contracts:

NAS2-12154 ARC PY 1983 Topic 08
"Advanced Components for Spaceborne Infrared Astronomy"

F.03

JF-4 Integrating Cryogenic Amplifier

Firm: Infrared Laboratories, Inc.

The JF-4 is a single-channel, integrating amplifier module designed for use with infrared detectors operating in the temperature range from 1 to 45 K. It consists of a hybrid circuit containing a balanced JFET integrating amplifier with voltage gain of 0.90, an input capacitance of 7.5 pf, and a read noise of less than 20 electrons. The charge-compensated JFET reset switch provides for rapid and accurate reset of the input-to-ground potential, and the device is designed for continuous non-destructive read-out by sampling the output. Output impedance is less than 100 K ohms. Power

dissipation, including heater power, is less than 250 microwatts at a temperature of 4 K.

Applications: Low-noise, cryogenic, integrating amplifier for use with infrared detectors (bolometers, photodetectors, and detectors made of extrinsic silicon or indium antimonide). Well suited for both laboratory and space flight applications.

Contact: Eric Low
602-622-7074

Related SBIR Contracts:
NAS2-12154 ARC PY 1983 Topic 08
"Advanced Components for Spaceborne Infrared Astronomy"

F.04

Automated Reliability Test Set for Electronic Modules

Firm: **Shason Microwave Corporation**

This product is a computer test set to control, monitor, and record the accelerated life-testing of electronic assemblies. The computer controller is menu driven for a user-friendly interface. The results of the long-duration controlled testing can be used to calculate and/or verify the mean-time-to-failure (MTTF) of most electronic assemblies.

Applications: This automated reliability test set can be used to measure product MTTF. This information can then be used in the quality and reliability engineering of complex electronic systems such as radar systems and solid-state communication systems.

Contact: Roland Shaw
713-333-1950

Related SBIR Contracts:
NAS9-18358 JSC PY 1988 Topic 14
"Integrated Active Antenna Module for Space Station Multiple Access Communication"

F.05

Wireless Headset Network

Firm: **Telenexus, Inc.**

The Wireless Headset Network is a self-contained voice-communication system with one base station supporting up to 16 full-duplex headset units. Each headset unit can communicate with any unit in the system, either privately or in groups.

Applications: Industrial communications, military tactical communication, training systems, search and rescue operation, entertainment production, other task coordination applications.

Contact: Chuck Lau
214-423-0667

Related SBIR Contracts:
NAS10-11607 KSC PY 1987 Topic 13
"A Wireless Headset Network"

G: Microwave Electronic Devices

G.01

Custom, Fully Monolithic GaAs Switch Matrix Subsystems

Firm: **Microwave Monolithics, Inc.**

This product is a family of custom, fully monolithic, microwave switch matrices fabricated in gallium arsenide using monolithic microwave integrated circuit technology. Microwave Monolithics's ULSI monolithic implementation features GaAs field-effect transistors utilized as passive switches and proprietary fabrication technology to achieve performance heretofore unattainable in fully monolithic form. Fully monolithic implementation is the key to small size, light weight, and high reliability. A novel packaging approach complements the monolithic switch matrix and preserves the low on-chip crosstalk levels. An internal controller is typically included for system interfacing and control, and fixed-gain buffer amplifiers can be optionally included within the package to set subsystem gain. This custom product line is fully compatible with a wide range of matrix sizes, operating modes, configurations, and frequency bands. As an example, a packaged 6 X 6 IF switch matrix subsystem, including the switching MMIC, buffer amplifiers, and an internal controller capable of autonomous TDMA operation, is currently being fabricated for Lewis Research Center. This advanced subsystem occupies just 3.8" X 3.8" X 1.15", or 16.6 cubic inches (excluding connectors), and weighs a mere 1.5 pounds. Nominal insertion loss is 0 dB, and isolation is greater than 60 dB across the specified band of 3 to 6 GHz.

Applications: In addition to a wide variety of multi-beam satellite switching applications, other custom versions of the monolithic switch matrix could find use in systems ranging from ground-based wideband communications systems (including data, voice, and video distribution) to high-speed automated test equipment. Commercial and military radar systems would benefit from the flexible signal-routing capabilities inherent in switch-matrix architectures, and electronic countermeasures equipment could become more responsive to rapidly changing electromagnetic environments.

Contact: Daniel R. Ch'en
805-584-6642

Related SBIR Contracts:

NAS3-24252 LeRC PY 1983 Topic 14
"Advanced Monolithic GaAs IF Switch Matrix"

G.02

Solid-State Active Ku-Band Antenna

Firm: **Shason Microwave Corporation**

This solid-state active antenna combines the latest advances in microwave-frequency integrated circuits with state-of-the-art printed-circuit antenna fabrication to produce a full-duplex transmit and receive module. This module is used in high-technology electronic systems such as radar systems, solid-state phased-array antenna systems, satellite communication systems, and other systems that involve the reception or transmission of high-frequency radio waves.

Applications: This active antenna module can be used on a communications system or radar system to improve both the transmitted and received signal strength. The active antenna can be used as a single antenna element or combined with numerous identical antennas to form an array of elements.

Contact: Roland Shaw
713-333-1950

Related SBIR Contracts:

NAS9-18358 JSC PY 1988 Topic 14
"Integrated Active Antenna Module for Space Station Multiple Access Communication"

H: Optical Devices and Lasers

H.01

Solid State Laser Scanner

Firm: **APA Optics, Inc.**

APA Optics has demonstrated a high-speed solid-state device for scanning a laser beam without the use of moving components. Bragg diffraction gratings are electro-optically established using semiconductor pn junctions in epitaxial $\text{Al}_x\text{Ga}_{1-x}\text{As}$ waveguides to deflect angularly the guided laser beam. An integrated-optic, solid-state scanner offers the benefits of no moving parts, reduced size and mass, improved reliability, low cost, and low operating power.

Applications: The scanner will find application in the areas of optical interconnects, ranging, optical cross-bar switches, and laser ordnance initiators. Currently, laser scanning technology is being studied for Air Force laser-switching applications and for an automobile collision warning system.

Contact: O.H. Linquist
612-784-4995

Related SBIR Contracts:

NAS9-17813 JSC PY 1985 Topic 06
"Integrated Optic Device for Laser Beam Scanning"

H.02

Model 100 Profilometer

Firm: **Bauer Associates, Inc.**

The Model 100 is a noncontacting, optical profilometer for ultra-accurate measurements of surface contours on aspheric optics. The Model 100 is easy to use and routinely achieves Angstrom-level accuracy for scan lengths from under 5 mm to over 200 mm. It is self-aligning and accommodates flat, convex, or concave test pieces.

Applications: The Model 100 is an excellent tool for measuring surface quality of spheric or aspheric optics used in visible, infrared, ultra-violet, and x-ray systems.

Contact: Paul Glenn
617-235-8775

Related SBIR Contracts:

NAS5-30311 GSFC PY 1986 Topic 08
"Measurement of Upper-Mid-Frequency Errors on Arbitrary Grazing Incidence Optics"

H.03

Eagle 3004 Vision System

Firm: **Coleman Research Corporation, Digital Signal Division**

The Eagle 3004 is a three-dimensional vision system employing coherent detection of frequency-modulated laser radar signals. It makes a direct, unambiguous measurement of the absolute distance to any arbitrary surface in any lighting, including direct sunlight and total shade. The system has an operating range of up to 5 m with a resolution of 4 mm and maintains a sustained throughput of 262,144 measurements per second. Related systems measuring at slower rates can obtain resolutions of less than 10 microns. Fiber-optic coupled versions are also available.

Applications: Three-dimensional robot guidance and control, autonomous vehicle guidance and control, telerobotics, artificial intelligence development, inspection systems, process monitoring, factory automation, non-destructive evaluation.

Contact: Tony Slotwinski
703-719-9200

Related SBIR Contracts:

NAS1-18890 LaRC PY 1987 Topic 05
"Improvement of Range of Coherent Laser Radar"

H.04

Alpha-Numeric Electrochromic Displays

Firm: EIC Laboratories, Inc.

The alpha-numeric electrochromic displays have a memory, can retain images indefinitely with no power drain, and are capable of >5,000 switching cycles.

Applications: These alpha-numeric displays can be applied in portable computers, aircraft cockpits, automobiles, portable sensing equipment, and any device where power is limited.

Contact: Dennis N. Crouse
617-769-9450

Related SBIR Contracts:

NAS9-18169 JSC PY 1987 Topic 12
"Variable Transmittance Electrochromic Space Suit Visor"

H.05

Multimode Optical Switch and Control Unit

Firm: Geo-Centers, Inc.

The product is a fiber-optic, single-pole, double-throw optical switch compatible with multimode fiber-optic and electronics interfaces to control switch operations. The switch is unique in that it has no moving parts and can be activated in less than 1 μ s.

Applications: The switch has been designed for use in optical engine control systems. It provides a cost-effective means of interfacing arrays of optical sensors to a single optoelectronic interface. It will find additional applications in other areas where multiple optical sensors are used.

Contact: Bruce N. Nelson
617-964-7070

Related SBIR Contracts:

NAS3-25947 LeRC PY 1988 Topic 01
"Fast Optical Switch for Multimode Fiber Optics"

H.06

Series 120 Diode-Pumped Solid-State Ring Laser

Firm: Lightwave Electronics Corporation

The Series 120 Nd:YAG Non-Planar Ring Laser is a source of ultra-narrow linewidth, frequency-stable laser light at either 1064 or 1319 nm. Laser-diode pumping of unprecedented compactness and efficiency is incorporated. A patented monolithic ring cavity configuration ensures stable single-frequency output at high power levels.

Applications: The Series 120 laser is suitable for a variety of applications including fiber-optic sensing, difference frequency generation, video bandwidth communication, infrared interferometry, and more.

Contact: Tim Gray
415-962-0755

Related SBIR Contracts:

NAS7-999 JPL PY 1985 Topic 14
"Prototype Laser-Diode-Pumped Solid-State Laser Transmitter"

H.07

Series 122 Diode-Pumped Solid-State Non-Planar Ring Laser

Firm: Lightwave Electronics Corporation

The Series 122 Diode-Pumped Solid-State Non-Planar Ring Laser is a source of single-frequency, narrow-linewidth, frequency-stable, frequency-tunable, ultra-low-noise laser light at either 1064 or 1319 nm. Laser-diode pumping is incorporated for unprecedented compactness and efficiency. This Nd:YAG laser utilizes a patented monolithic ring cavity configuration to ensure stable single-frequency output at high-power levels. An active noise-reduction system provides a specified output noise level of less than 0.1 percent rms and a microprocessor-controlled power supply makes the laser system easy to use as well as offers computer interfacing capability.

Applications: The Series 122 laser will find use in applications such as wide-bandwidth analog communication, single-mode fiber studies and applications, difference frequency generation, holography and other interferometric studies, coherent optical communication, resonant frequency doubling, and others.

Contact: Thomas J. Kane
415-962-0755

Related SBIR Contracts:

NAS7-999 JPL PY 1985 Topic 14
"Prototype Laser-Diode-Pumped Solid-State Laser Transmitter"

H.08

Cobra 2000 Laser

Firm: Schwartz Electro-Optics, Inc.

The Cobra 2000 is a tunable solid-state laser based on the cobalt-doped magnesium fluoride (Co:MgF₂) crystal. The laser provides from tens of millijoules to 900 millijoules of tunable radiation over the 1750-2500 nm wavelength region.

Related SBIR Contracts:

NAS7-999 JPL PY 1985 Topic 14
"Prototype Laser-Diode-Pumped Solid-State Laser Transmitter"

H.08

Cobra 2000 Laser

Firm: **Schwartz Electro-Optics, Inc.**

The Cobra 2000 is a tunable solid-state laser based on the cobalt-doped magnesium fluoride (Co:MgF₂) crystal. The laser provides from tens of millijoules to 900 millijoules of tunable radiation over the 1750-2500 nm wavelength region.

Applications: Excitation and local and remote sensing of gases such as H₂O, CO₂, CO, CH₄, N₂O, HF, HI, and NO₂; medical laser systems based on the ability to control tissue-penetration depth via wavelength tunability; testing of low-loss silica and fluoride fibers in the near IR.

Contact: Craig Smith
407-298-1802

Related SBIR Contracts:

NAS1-18442 LaRC PY 1985 Topic 08
"Cobalt-Doped Magnesium Fluoride Laser for Remote Sensing"

H.09

Yttrium-Aluminum-Garnet Laser Rods

Firm: **Scientific Materials Corporation**

ND:YAG and CTH:YAG laser rods with the SciMax label are of the highest quality. SM has developed manufacturing processes which improve the uniformity of production crystals, generating a SciMax L.S. Grade line of YAG laser rods.

Applications: SciMax YAG laser rods and crystals are used in components for solid-state lasers. The crystals are engineered for specific wavelengths of laser radiation for applications in medical systems, scientific R&D, telecommunication, fiber optics, industrial and military systems.

Contact: Edward J. Niemczyk
406-585-3772

Related SBIR Contracts:

NAS1-18857 LaRC PY 1987 Topic 08
"A Method to Provide Lower Cost Crystal Properties Study Samples"

H.10

Omniview

Firm: **TeleRobotics International, Inc.**

The Omniview Camera System provides the capability to electronically pan, tilt, rotate, and zoom

within a hemispherical field of view. Absence of mechanical mechanisms improves reliability, and electronic control of viewing parameters provides flexible viewing situations. Multiple output images are possible with a single camera. Individual view can be zoomed, rotated, or sized independently.

Applications: Remote viewing in constrained environments, object tracking, wide-angle viewing, surveillance, reconnaissance, single-camera multi-view applications.

Contact: Steve Zimmermann
615-690-5600

Related SBIR Contracts:

NAS1-18855 LaRC PY 1987 Topic 07
"Electro-Optical Pan/Tilt/Zoom"

H.11 See Addendum, page 39, column 2

I: Advanced Materials

I.01

Biaxially Oriented Liquid Crystal Polymer Film

Firm: **Foster-Miller, Inc.**

The low-dielectric constant (less than 3.0), low-water-absorption (less than 0.1 percent), high-melt-temperature thermoplastic (270°C) can be extruded into thin dielectric layers. This extended substrate can be further refined to produce an in-plane coefficient of thermal expansion (CTE) that can range from 0 ppm/°C to 30 ppm/°C. By matching the substrate CTE to the CTE of the electrical component, such as leadless ceramic chip carriers, thermal cycling-induced solder joint failures can be significantly reduced.

Applications: Multilayer packaging of high I/O and VHSIC devices using SMT, as well as applications in flexible printed circuits, tape automated bonding, and laminated multichip modules.

Contact: Leslie S. Rubin
617-890-3200

Related SBIR Contracts:

NAS5-31404 GSFC PY 1990 Topic 04
"Liquid Crystal Polymers for Coefficient of Thermal Expansion Matched PWBs."

I.02

Foster-Miller Polymer Reaction Monitor

Firm: **Foster-Miller, Inc.**

The In Situ Fiber-Optic Polymer-Reaction Monitor is the first analytical system capable of directly measuring reaction chemistry in a wide variety of

spectrometer and return it, and an optical fiber sensor. To date, the principal application for the system is as an in-process monitor for controlling the manufacture of advanced carbon-fiber composite materials. A large number of applications is envisioned for the technology presented by this development. Traditional infrared sampling practice requires that the specimen to be analyzed be brought into the spectroscopy laboratory. Sampling with fiber optic spectroscopy eliminates that requirement. Therefore, infrared spectroscopy can be used outside of the laboratory and in the manufacturing or process development environment.

Applications: Monitoring thin film coatings on food-packaging materials; solution polymerization reactions for plastics manufacture; low-level detection of analytes in biological substances; composite cure monitoring.

Contact: Mark Druy
617-890-3200

Related SBIR Contracts:
NAS1-18659 LaRC PY 1986 Topic 04
"In Situ, Fiber-Optic Sensor for FTIR Monitoring of Composite Cure Cycles"

1.03

Polyamide/Liquid-Crystal-Polymer Blend

Firm: **Foster-Miller, Inc.**

PI/LCP Blend Structures represent a new class of "Polymer Microcomposites" with performance superior to currently available polymer systems. Through a proprietary process, Foster-Miller has developed the means of producing biaxially oriented structures that exhibit near zero coefficient of thermal expansion (CTE), ultra-high stiffness (2 Mpsi in film form), and high tensile strength (≈ 70 ksi in film form). Foster-Miller's manufacturing technology, based on a new extrusion die, helps overcome processing difficulties in the extrusion of high-viscosity, high-temperature thermoplastics. This processing technology can be used to process films, tubes, and rods.

Applications: Aircraft interior surfaces such as luggage compartment panels, electronics such as multichip modules, barrier films for food packaging, medical products such as balloon catheters for angioplasty, cryogenic tanks, and uses in the transportation, telecommunications, chemical and recreational equipment fields.

Contact: Ross Haighat, Richard Lusigne
617-890-3200

Related SBIR Contracts:
NAS1-19302 LaRC PY 1989 Topic 04
"Polyamide/Liquid-Crystal-Polymer Blend"

1.04

Distributed Fiber-Optic Composite-Material Cure Monitoring and Control System

Firm: **Geo-Centers, Inc.**

The product is a distributed, fiber-optic measurement system for use in composite-material fabrication. The system both monitors and controls autoclave temperature and pressure during composite-material fabrication. Additionally, it monitors the state of cure of the organic matrices used in these advanced materials. The system is unique in that as many as 50 independent sensors can be addressed by the system control interface.

Applications: The major application of the product is in monitoring and controlling the processing of advanced composite materials. Better control of these parameters during material fabrication should increase the manufacturing yield of these materials. The system is used for monitoring temperature and pressure by utilities, and in industrial process control and environmental monitoring applications.

Contact: Bruce N. Nelson
617-964-7070

Related SBIR Contracts:
NAS3-25817 LeRC PY 1987 Topic 04
"Embedded Fiber Optic Sensors for Polymer Matrix Composite Process Monitoring"

1.05

Tungsten and Molybdenum Alloys

Firm: **Metadyne, Inc.**

Precipitation-strengthened alloys of tungsten and molybdenum (Mo-Hf-C, Mo-Re-Hf-C, Mo-W-Hf-C) have been developed for elevated temperature applications. These products are manufactured by using powder metallurgy techniques. The alloys are available in forms of ingot, rod, and fibers for further use in component manufacturing.

Applications: Refractory metal alloys of tungsten and molybdenum have excellent elevated temperature strengths and therefore are suitable for applications requiring extended exposure at elevated temperatures. Some commercial applications are: fiber-reinforced superalloys, isothermal forging dies, furnace components, and space power components.

Contact: Raman L. Daga
607-732-1300

Related SBIR Contracts:
NAS3-25149 LeRC PY 1985 Topic 04
"High-Strength, Refractory-Metal Fibers by Advanced Powder Metallurgy"

I.06

CVD Silicon Carbide™

Firm: Morton International

CVD Silicon Carbide™ is a theoretically dense, fine-grained, highly pure (both chemical and phase purity) material possessing superior thermal, mechanical, and optical properties. The polycrystalline material is produced via the chemical vapor deposition (CVD) method. The material's hardness, thermal characteristics, stiffness, polishability, and non-toxic nature make it an attractive candidate material for many applications.

Applications: Potential uses include: substrate material for optical mirrors for ground or space based telescopes; synchrotron optics; structural applications; coating for wear components; electronic ceramics.

Contact: William R. Halgls
617-933-9243

Related SBIR Contracts:

NAS1-18476 LaRC PY 1985 Topic 08
"Fabrication of Light Weight Silicon/Silicon Carbide LIDAR Mirrors"

I.07

Titanium Fibers, Filaments, Strips, and Foils

Firm: Ribbon Technology Corporation

Ribtec produces rapidly solidified titanium-alloy ribbons, fibers, filaments, strips, and foils. Titanium foils are 100 mm (4") wide, and up to 2 m (6') long. Titanium fibers and filaments range from 100 μ m to 0.5 mm effective diameter. Ribbons are as narrow as 2 mm and as thick as 0.5 mm. Titanium strip is cast to 100 mm (4") wide and 0.5 mm thick.

Applications:

Foils: honeycomb structures, metal matrix composites; strips; engine flaps.

Ribbons: metal matrix composites.

Fibers and Filaments: catalyst supports, filters, prosthetic devices.

Contact: Thomas Gaspar
614-864-5444

Related SBIR Contracts:

NAS1-18288 LaRC PY 1984 Topic 01
"Rapidly Solidified Titanium Alloys by Melt Overflow."

I.08

Clean-Room Floor Tile Covering

Firm: Springborn Laboratories, Inc.

This product is a specialized floor-covering package (tile and adhesive) that meets the requirements of a Class 100 Clean Room. It is easily

cleaned by a water/alcohol wet mop; chemically resistant to hypergolic materials; non-particle generating; low outgassing (ASTM E-505, 1 percent total mass loss, 0.1 percent total collected volatile, condensable materials); antistatic, 10^{-7} ohms resistance; and exceeds NFPA Class 1 flammability requirements.

Applications: Recommended for clean-room installations up to Class 100, or other environments requiring excellent chemical resistance, static dissipation, and unique non-outgassing characteristics.

Contact: James P. Galica
203-749-8371

Related SBIR Contracts:

NAS10-11552 KSC PY 1987 Topic 04
"A Specialized Floor Covering for Launch Site Facilities"

J: Materials Processing

J.01

DIFKIN, A Coupled-Mass Transport and Chemical Kinetics Code for CVD Modeling

Firm: Aerodyne Research, Inc.

The DIFKIN code solves the governing equations for coupled-mass transport and finite-rate chemistry in a two-dimensional flow. This flow configuration is an idealization of the deposition region in a CVD reactor, in which the reactants flow horizontally over a tilted, flat substrate within a water-cooled tube. A deposition chemistry model using reactive sticking coefficients for each gas-phase species provides the diffusion boundary conditions and allows the prediction of deposition rates and distribution of depositing species.

Applications: In a comparison to observations in the NASA SIC CVD reactor, the DIFKIN model predictions agreed reasonably well. These comparisons demonstrate that a coupled diffusion and finite-rate chemistry approach is required to model SIC CVD, and that the present model is useful in investigating chemical effects in CVD.

Contact: Kurt D. Annen
508-663-9500

Related SBIR Contracts:

NAS3-24531 LeRC PY 1984 Topic 08
"Optimization of Silicon Carbide Production"

J.02

Real-Time, Adaptive-Vision Welding Guidance System

Firm: International Technical Associates

The product is a three-dimensional laser vision system that is able to track a seam in real-time and provide corrections to a servo system in order to guide the path of a welder. The vision system is designed to be flexible and rugged, and can operate in the welding environment without loss of tracking accuracy.

Applications: Seam tracking, feature location, feature measurement, height measurement.

Contact: Phil Barone
408-748-9955

Related SBIR Contracts:

NAS8-38409 MSFC PY 1987 Topic 04
"Real-Time, Adaptive-Vision Welding Guidance System Demonstration"

J.03

Model 1000 Welding Controller

Firm: Mid-South Engineering, Inc.

The Model 1000 Welding Controller is a gas tungsten arc welding (GTAW) control system with numerous useful features for industrial applications: computer models allow pre-process (off-line) parameter selections; weld programmer allows selection of operating parameters (current, voltage, etc.) on a common time base; digital automatic voltage control gives enhanced control capability; graphical displays allow easy operator programming and interpretation; Microsoft Windows® environment allows easy software maintenance and upgrades.

Applications: The system has application in any situation where gas tungsten arc welding is performed. The flexibility and precision of the system makes it particularly suitable for aerospace, automotive, military, and nuclear applications.

Contact: Kristinn Anderson, Joel Barnett
615-383-8877

Related SBIR Contracts:

NAS8-37401 MSFC PY 1986 Topic 04
"Intelligent, Gas-Tungsten-Arc Welding Control"

J.04

Ion-Beam-Assisted Deposition

Firm: Spire Corporation, Surface Engineering Division

Ion-beam-assisted deposition (IBAD), in which physical vapor deposition is combined with simul-

taneous ion bombardment, produces highly adherent metal, ceramic, and diamond-like coatings. The coatings can be applied to a broad range of surfaces, including plastics.

Applications: IBAD coatings provide excellent oxidation wear and corrosion resistance for materials used in aerospace, medical, chemical, and manufacturing applications.

Contact: Bruce Haywood
617-275-6000

Related SBIR Contracts:

NAS3-25326 LeRC PY 1987 Topic 04
"Oxidation Resistant Ti/6Al/4V-SiC Composite Materials by Ion-Beam Processing"

J.05

longuard® Surface Treatment

Firm: Spire Corporation, Surface Engineering Division

longuard® is Spire's proprietary processing service that improves the wear-, corrosion-, and fatigue-resistance and other surface properties of a wide range of finished components. In the process, an ion implanter accelerates a beam of ionized atoms to such a high velocity that the ions are embedded in the near-surface region of the target, resulting in improved surface properties. Spire has eight in-house implanters and offers ion species of all stable elements to treat a wide range of metal alloys, ceramics, and polymer materials.

Spire Corporation has recently completed the development of longuard® 3000 for enhancing the surface properties of titanium and its alloys. An assortment of FDA-approved products, such as prosthetic hips and knees, benefit from increased microhardness and lower friction. longuard® improves hardness, wear, and fretting resistance without adversely affecting bulk material properties; produces a significant increase in prosthetic product performance and patient comfort; improves corrosion resistance and minimizes ion release; minimizes particle debris from wear and fretting; provides resistance to fatigue in dynamic components; produces no dimensional or cosmetic change; results in FDA-approved products.

Applications: longuard processing has already contributed to many successful products. Applications in titanium-based alloys include: ball valves, chemical industry products, turbine blades, specialty fasteners, threaded components, etc. longuard® has been used for biomedical purposes in surface-hardened titanium alloy orthopaedic and dental components; fatigue resistant screws, plates, pins, and other fixation devices; wear-resistant polyethylene implantable components;

surgical instruments and tools; and low friction syringes, staples, and vascular access products.

Contact: Bruce Haywood
617-275-6000

Related SBIR Contracts:
NAS8-35262 MSFC PY 1983 Topic 11
"Dry-Film Lubricant for Bearings Using Ion
Implantation"

J.06

EO-1500 Spectral Contents Analyzer

Firm: **Strainoptic Technologies, Inc.**

The instrument measures stress-induced birefringence in transparent materials. To accomplish this task, a dedicated spectrophotometer recognizes and quantifies the optical retardation in polarized light submitted by an item exhibiting stress birefringence. The package includes a fiber-optic light source, a dedicated spectrophotometer, and a PC-based A/D converter. The software developed to interpret the spectral analysis permits accurate, non-contacting stress/strain measurement at high speed and elevated temperature.

Applications: The system marketed by Strainoptic is used to measure residual stress in glass products, monitor float-glass process, measure and monitor polymer-orientation in production of biaxially oriented films, and measure stress in glass at elevated temperatures.

Contact: Alex S. Redner
215-661-0100

Related SBIR Contracts:
NAS2-12666 ARC PY 1985 Topic 03
"Spectral Contents Readout of Birefringent Sensors"

K: Materials Testing and NDE

K.01

High-Energy, Dual-Energy Computed Tomography Detector Package

Firm: **Advanced Research and Applications Corporation**

This innovative detector package has been developed to provide good-resolution (≥ 3 linepairs/mm) dual-energy computed tomography (CT) data at linear-accelerator energies (≥ 2 MeV). With its moderately high spatial resolution, high-energy design, and dual-energy capability, it is ideally suited for the inspection of large metal-matrix composite structures. The detector is also compatible with a standard load frame.

Applications: This detector, as part of a larger CT system, will provide key information needed by computer codes to generate better designs of structural components and more accurate predictions of in-service performance.

Contact: Jim Wiedeman, Jim Stanley
408-733-7780

Related SBIR Contracts:
NAS1-19093 LaRC PY 1988 Topic 04
"Dual-Energy Detector Package for Advanced Structures"

K.02

QUEST Integrated Load-Frame and Computed-Tomography System

Firm: **Advanced Research and Applications Corporation**

The QUEST (quantitative experimental stress tomography) Laboratory System is an integrated material testing system combining the performance of a standard load frame with the inspection capabilities of a high-resolution computed tomography (CT) instrument. The load frame is a closed-loop system with a ± 500 kN capacity and the ability to measure all signal variables needed to conduct and evaluate compression, tension, or mixed-mode static and dynamic material tests. Additionally, the instrument has the ability to "pause and hold" a test at any point prior to catastrophic specimen failure and perform CT inspections of any or all cross sections of the specimen while maintaining the load. The CT system has a spatial resolution of 50 microns.

Applications: The QUEST system was developed so that material systems can be evaluated before, during, and after mechanical loading. The information will be used by computer codes to generate better designs of structural components and more accurate simulations of in-service performance.

Contact: Jim Wiedeman, Jim Stanley
408-733-7780

Related SBIR Contracts:
NAS1-18480 LaRC PY 1985 Topic 04
"QUEST Quantitative Experimental Stress Tomography (QUEST) Laboratory System"

K.03

Instrumented Torque Wrench (INTOWS)

Firm: **ANCO Engineers, Inc.**

INTOWS is a computer-based quality-assurance tool to ensure that all bolt-torquing operations are performed according to specified procedures and provide a documented history of torquing

operations. The system consists of an instrumented torque wrench, a handheld computer, and a barcode wand.

Applications: This portable, handheld system can be adapted to any situation where an approved quality-assurance procedure must be adhered to by an operator or technician.

Contact: Paul Ebanes
213-204-5050

Related SBIR Contracts:
NAS10-11501 KSC PY 1986 Topic 13
"Instrumented Torque Wrench"

K.04

Dual-Beam Lens for Micro-NDE

Firm: **Bio-Imaging Research, Inc.**

This product is a dual-beam lens for differential phase-contrast acoustic microscopy. It is an attachment to acoustic microscopes to allow higher resolution and generation of microscopic surface profiles of materials.

Applications: Materials characterization and evaluation, particularly inspection of surfaces of metals and composites for process evaluation.

Contact: Barbara R. Krohn
708-634-6425

Related SBIR Contracts:
NAS1-19099 LaRC PY 1988 Topic 04
"Differential-Phase, Acoustic Microscopy"

K.05

Dynamic Laser Speckle Profilometer (DyLASP)

Firm: **McMahan Electro-Optics**

The Dynamic Laser Speckle Profilometer (DyLASP) locates defects in composite and metallic materials and assemblies. It operates in real time and displays results as a contour map of the assembly under test, with defects indicated by size and location. Minimum isolation is needed for test. All operations are controlled from the CRT with a mouse. Standard configuration allows inspection of areas up to 1 square meter and can profile resonance behavior of the object under test from 1 to 50 kHz. The DyLASP incorporates advanced laser targeting and imaging techniques developed by McMahan Electro-Optics scientists and engineers for advanced Air Force weapons systems.

Applications: Defect location and characterization in composite materials; resonance behavior in assemblies; stress/strain fields.

Contact: Robert McMahan, Jr.
919-549-7575

Related SBIR Contracts:
NAS1-18848 LaRC PY 1987 Topic 13
"Dynamic Laser Speckle Profilometer"

K.06

Fast Atom Sample Tester (FAST™)

Firm: **Physical Sciences Inc.**

A pulsed, high-flux source of atomic oxygen has been developed and patented by Physical Sciences to perform accelerated erosion testing of spacecraft materials in a simulated low-earth-orbit environment. The device employs plasma formation in pure oxygen by laser-induced breakdown followed by hypersonic expansion to produce a relatively mono-energetic beam of oxygen atoms with velocity adjustable between 5 and 13 km/s. Fast oxygen atom fluxes of 10^{18} per pulse can be produced at 3 Hz, and the beam is expandable to areas of approximately 1000 cm².

Applications: Testing and aging certification of aerospace materials to be subjected to the low-earth-orbit environment. Surface modification applications.

Contact: Linda Cribbbs
508-689-0003

Related SBIR Contracts:
NAS7-963 JPL PY 1984 Topic 04
"Novel Oxygen Atom Source for Material Degradation Studies"

K.07

Thermoelectric Microprobe

Firm: **QCI, Inc.**

The thermoelectric voltage generated by contact between the heated probe and a room temperature specimen is used for sorting and identifying alloys by category of heat treatment history.

Applications: Checking that heat treatment of precipitation hardened alloys has been properly performed. Straightening out materials mixups in shops, chemical plants, and laboratories.

Contact: Roger W. Derby
615-483-6498

Related SBIR Contracts:
NAS1-18852 LaRC PY 1987 Topic 13
"Thermoelectric Instrumentation for Characterization of Precipitation-Hardening Alloys"

K.08

Z Sensor

Firm: **Radiation Monitoring Devices, Inc.**

A portable, nondestructive analysis system that can be used to sort materials based on the materials' average atomic number of each specimen.

Applications: The Z Sensor provides a method to identify unknown materials and is complementary to other analytical techniques such as x-ray fluorescence.

Contact: Michael R. Squillante
617-926-1167

Related SBIR Contracts:

NAS7-1032 JPL PY 1986 Topic 05
"Novel, Proportional Proximity Sensor for Space Robots"

L: Materials Instrumentation

L.01

Miniature Materials Analysis X-Ray Laboratory

Firm: **Advanced Research and Applications Corporation (ARACOR)**

The Miniature Materials Analysis X-Ray Laboratory is an extremely compact, low-mass, self-contained instrumentation system that accomplishes the x-ray diffraction and fluorescence analysis of materials (minerals, fuels and petroleum products, environmental contaminants) in the field setting. The system supports identification of polycrystalline samples by means of diffraction analysis, and enhanced fluorescence analysis for elements from carbon to molybdenum. Originally designed for the geological and exobiological surface exploration of the planet Mars, it is very robust, reliable, and portable. X-ray generator and electro-optic detector innovations have contributed to reducing substantially the dimensions and mass of the system.

Applications: The commercial applications of the Miniature X-Ray Laboratory include field exploration for mineral and petroleum resources, in situ materials-manufacturing process control, and environmental compliance monitoring.

Contact: Jim Wiedeman, Lou Koppel
408-733-7780

Related SBIR Contracts:

NAS2-13416 ARC PY 1989 Topic 08
"An Integrated Function X-Ray Laboratory for the Geological and Exobiological Exploration of Mars"

L.02

Multi-Color Imaging Pyrometer

Firm: **PSI Technology Company, Physical Sciences Inc.**

This instrument is a passive imaging pyrometer capable of measuring the temperature distribution across the surface of moving objects. Unlike infrared thermal imagers, the PSI pyrometer senses visible radiation to accurately measure temperatures between 600°C and 2200°C while minimizing errors associated with poorly known material emissivity. Images at six different wavelengths, from 450 to 950 nm, are projected concurrently onto a single CCD camera. The preferred wavelength for measurement of a particular temperature decreases as the temperature increases. The camera and optical system have been calibrated to relate the measured intensity at each pixel to the temperature of the heated object. The output of the camera is digitized by a frame grabber installed in a personal computer and analyzed automatically to yield temperature information. The data can be used in a feedback loop to alter the status of computer-activated switches and thereby to control a heating system.

Applications: The multi-color imaging pyrometer was designed to measure and control the temperatures of new materials subjected to thermal processing in a spaceborne laboratory. One use is in an acoustic levitation furnace in which material samples roughly 2 mm in diameter are heated to temperatures as high as 2500 K by a combination of radiant heating from the furnace walls and laser irradiation. Terrestrial applications include any high-temperature process where surface temperature fields must be measured and controlled. Custom-designed instruments to accommodate new applications are possible.

Contact: Michael B. Frisch
508-689-0003

Related SBIR Contracts:

NAS7-1002 JPL PY 1985 Topic 15
"Multi-Color Imaging Pyrometer for Materials Processing in Space"

L.03

Optical Temperature Monitor

Firm: **PSI Technology Company, Physical Sciences Inc.**

This device is a specialized multi-wavelength pyrometer designed to accurately measure temperatures between 700° and 2500°C of materials with emissive properties that are poorly understood or that change with time or temperature. Its output is coupled to a computer that can be programmed to control the heating process. Originally designed for application to materials manufacturing in

space, a commercial version of the instrument is now being developed for measuring and controlling temperatures in utility or industrial processes.

Applications: A specific application, for which the instrument is currently being tested, is the control of furnace exit-gas temperatures in utility boilers. Modified versions may find application in waste destruction and energy-intensive manufacturing processes such as steel, glass, cement, petrochemicals, pulp, and paper production.

Contact: Michael B. Frisch
508-689-0003

Related SBIR Contracts:

NAS7-1002 JPL PY 1985 Topic 15
"Multi-Color Pyrometer for Materials Processing in Space"

L.04

Space Rated, Rugged, Compact Time-of-Flight Mass Spectrometer

Firm: **Schmidt Instruments, Inc.**

The Time-of-Flight Mass Spectrometer is small, rugged, and lightweight. It includes a hot filament ionizer with redundant filaments; complete power supply, control, and data acquisition electronics; serial control; and RS-485 data interface.

Applications: Materials processing; on-orbit environmental monitor; non-volatile residue sensor; residual gas analyzer.

Contact: Howard K. Schmidt, Lloyd Bridges,
Michael Clark
713-529-9040

Related SBIR Contracts:

NAS3-25971 LeRC PY 1988 Topic 08
"Autonomous Leak Detector for Orbiting Spacecraft (ALDOS) Development"

M: Aerodynamics and Aircraft

M.01

An Optical Angle-of-Attack Sensor

Firm: **Comptech, Inc.**

This novel, laser-based instrument for the in situ measurement of wind tunnel model angle of attack enables continuous, time-dependent measurements to be made without signal dropout. The instrument also accounts for the largely unknown effects of model deflections and distortions due to changes in free-stream dynamic pressure and temperature. Detectors capable of 0.005 degree resolution over a 20 degree range and 0.01 degree resolution over a 40 degree range with time-

dependent outputs of 60 Hz have been developed.

Applications: This new instrument greatly improves wind tunnel testing efficiency and measurement accuracy as it removes the need for tedious and time-consuming model check-loading that is now required to estimate sting and balance deflections under wind tunnel dynamic loads. It provides sufficient angle-of-attack measurement accuracy for both transport and fighter model testing. The instrument has been successfully tested in the NASA Ames 9 x 7 foot Supersonic Wind Tunnel, and a new instrument is being built for the NASA Ames 11 foot Transonic Wind Tunnel.

Contact: F. Kevin Owen
415-321-5630

Related SBIR Contracts:

NAS2-13202 ARC PY 1987 Topic 08
"An Optical Angle-of-Attack Sensor"

M.02

EHPIC Mod 2.0

Firm: **Continuum Dynamics, Inc.**

The "EHPIC" software predicts performance of a general helicopter rotor in hover and axial climb. The analysis utilizes a free-wake model based on curved vortex filaments and converges the wake using an influence coefficient methodology. This innovative influence coefficient technique eliminates problems with converging a hydrodynamically unstable wake in the time domain. Commercial licensees of "EHPIC" claim superior accuracy over competing software.

Applications: The hover performance software can be used to develop new rotor designs as well as evaluate existing rotor systems.

Contact: Todd R. Quackenbush
609-734-9282

Related SBIR Contracts:

NAS2-12148 ARC PY 1983 Topic 03
"State-of-the-Art Rotary Wing Hover Performance Analysis"

M.03

RotorCRAFT

Firm: **Continuum Dynamics, Inc.**

The RotorCRAFT code provides a comprehensive analysis of performance and unsteady blade-loading for isolated helicopter rotors. It employs a novel full-span constant vorticity contour free-wake model, a vortex lattice presentation of the blades, and a finite-element model of structural deflection.

Applications: RotorCRAFT may be used to predict the aerodynamic loading on a wide range of rotor designs operating at any speed from transition to high-speed cruise.

Contact: Todd R. Quackenbush
609-734-9282

Related SBIR Contracts:
NAS2-12838 ARC PY 1986 Topic 02
"An Advanced Free Wake Analysis for Unsteady Airloads"

M.04 **Force and Moment Balance for Water Tunnels**

Firm: **Eidetics International, Inc.**

Three-component (expandable to five-component) force and moment balance that measures roll moment, either pitch or yaw moments, and either normal or side force depending on the balance orientation. (The five-component system measures all components simultaneously.) Balance and calibration hardware can be provided. Software to acquire and reduce balance data is being developed.

Applications: Measurement of forces and moments on scaled models of aircraft configuration in low-speed flow visualization water tunnels.

Contact: Gerald Malcolm
213-326-8228

Related SBIR Contracts:
NAS2-13302 (Phase I) ARC PY 1990
Topic 02
"A Multiple Component Force and Moment Balance for Water Tunnel Applications"

M.05 **Forebody Vortex Control**

Firm: **Eidetics International, Inc.**

Forebody vortex control by blowing from small nozzles at the nose of a NASP-type aircraft is used to reduce or eliminate low-speed roll instability (wing rock). Control of the forebody vortices results in the indirect control of the wing vortices, which provides aerodynamic control of the vehicle rolling moment and suppression of wing rock.

Applications: Wing rock suppression/yawing moment control at medium to high angles of attack.

Contact: Gerald Malcolm/Carlos Suarez
213-326-8228

Related SBIR Contracts:
NAS2-13196 (Phase II) ARC PY 1988
Topic 02
"A Vortex Control System for the NASP"

M.06 **Burst Frequency Processor**

Firm: **Physical Research, Inc.**

A multi-channel, ultra high-speed laser velocimetry processing system designed for high flows and low-power Doppler signals. The system is capable of recording the raw Doppler signal from up to three components of a laser velocimeter in real time and post-processing the data using frequency domain signal-processing techniques. Its modular construction allows for easy addition of channels or upgrading of signal processing capabilities.

Applications: Use in supersonic and hypersonic wind tunnels as a laser anemometer measuring tool; needed for the development and design of future hypersonic aircraft.

Contact: Dariush Modarress
213-378-0056

Related SBIR Contracts:
NAS2-13268 ARC PY 1988 Topic 02
"Laser Velocimetry Processor for Hypersonic Flows"

N: Fluid Mechanics and Measurement

N.01 **Rayleigh Scattering Diagnostic for Density and Temperature Measurements**

Firm: **Aerodyne Research, Inc.**

The system performs measurements of gas density and temperature at rates of up to 10 KHz. It utilizes both the 510 nm and 578 nm lines of a copper vapor laser in measuring the Rayleigh scattering signal and in subtracting out surface-scattered light. The system features a 1-inch-diameter probe containing the laser focusing optics, the collection optics, and a pressure transducer. The probe is water-cooled, and the optics and pressure transducer are protected with a purge-gas flow for use in combustion environments. The system includes PC-based data acquisition and reduction.

Applications: Experiments conducted at Aerodyne and NASA Lewis on nitrogen at room temperature and pressure, demonstrated a temperature accuracy of about 2 percent, a percentage uncertainty which is expected to pertain as well for the nominal design conditions of 1200 K and 20 atm.

pressure. Experiments performed at NASA Lewis in an open jet burner showed very good agreement with thermocoupled data.

Contact: Kurt D. Annen
508-663-9500

Related SBIR Contracts:
NAS3-24613 LeRC PY 1983 Topic 01
"A Rayleigh Scattering Diagnostic for Density and Temperature Measurements"

N.02

The Phase Doppler Particle Analyzer

Firm: **Aerometrics, Inc.**

The Phase Doppler Particle Analyzer (PDPA) is a laser-based particle-analysis system that measures size and velocity of particles passing through a measurement-probe volume. These measurements occur simultaneously and are displayed in any of several user-specified formats via Aerometrics' software. Aerometrics offers standard or fiber-optic one-, two-, or three-component PDPA systems, that can be used to conduct flow testing in three orthogonal directions. The PDPA is designed for use in measuring spherical particles that are between 0.5 and 10,000 micrometers in diameter. Aerometrics will customize any PDPA system to fit demanding or unusual testing conditions and frequently provides accessories, also often customized, which complement and enhance the PDPA capabilities. The PDPA system includes: transmitting optics, receiving optics, a signal processor, system software, and, if the system is fiber-optic, a fiber drive. Aerometrics does not make, but will provide, lasers and computer systems.

Applications: Spray nozzle development: gas turbines, fuels, paints, agricultural sprays, and medical nebulizers. Particle field characterization: two-phase flows, spray combustion, diesel spray formation, metal powder formation, polymer bead studies, chemical processes, spray drying, scrubbers, aircraft icing, condensation, sedimentation, cavitation and microbubbles, meteorology, clouds, aerosols, and fogs.

Contact: William D. Bachalo
408-738-6688

Related SBIR Contracts:
NAS3-25204 LeRC PY 1985 Topic 01
"Fuel Atomization and Air-Fuel Interactions in a Turbulent Environment (The Phase Doppler Particle Analyzer)"

N.03

PHLOW

Firm: **Computational Mechanics Company, Inc.**

PHLOW is an X-Window-based software package that may be used for simulating laminar and turbulent incompressible flows. The code has been designed to operate on fully unstructured meshes and to use H-refinement and P-enrichment to systematically reduce the error in the numerical solution. The code has a versatile, user-friendly pre-processor and special graphics package designed for spectral types of elements. The code is operational on several platforms ranging from the workstation class of machines (Apollo, SGI, Sony, Sun) to mini-supercomputers and supercomputers.

Applications: Modeling the flow through coolant chambers and ducts of mechanical systems. Predicting the flow field and recirculation regions in the SSME. There is also great potential for applications in the HVAC, automotive, and food industries.

Contact: Steve Kennon
512-467-0618

Related SBIR Contracts:
NAS8-38404 MSFC PY 1987 Topic 02
"Adaptive Schemes for Complex, Subsonic, Three-Dimensional Flow Problems in Arbitrary Domains"

N.04

Optical-Fiber Temperature Sensor

Firm: **Conax Buffalo Corporation**

The optical-fiber temperature sensor consists of a high-temperature lightguide with an integral, emissive source coupled through fiber-optic cable to a conversion-electronics package that translates optical intensity to probe temperature.

Applications: Turbine-engine, gas-path temperature measurement.

Contact: Samuel Algera
716-684-4500

Related SBIR Contracts:
NAS3-25451 LeRC PY 1986 Topic 01
"Durable, Fast-Response, Optical Fiber Temperature Sensor Usable from 200 to 1700°C"

N.05

NEKTON® Fluid-Flow Numerical Simulator

Firm: **Fluent, Inc.**

NEKTON is a powerful fluid-flow modelling package based on a finite-element technique known

as the spectral element method for the simulation of two- and three-dimensional unsteady, incompressible fluid flow and heat transfer. It provides high-order accuracy while retaining geometric flexibility. NEKTON solves general moving-boundary problems (including free surface, moving walls, multiple fluid layers, and moving melt fronts) with conjugate heat transfer, heat generation, and/or forced and natural convection in Newtonian and non-Newtonian fluids. NEKTON is an attractive tool for the analysis of material processing, biological flow, and flow measurement. NEKTON's pre- and post-processors allow problem geometries and parameters to be specified directly with a mouse and pull-down menus in a Motif/X-Window environment.

Applications: Polymer processing, glass processing, extrusion, crystal growth, biological flows, heat exchanger design, electronics cooling, furnace modeling, metals processing.

Contact: S. Subbiah
603-643-2600

Related SBIR Contracts:
NAS1-18831 LaRC PY 1988 Topic 15
"Chemical Vapor Deposition Fluid-Flow Simulation Modelling Tool"

N.06 Particle Tracking Computer Software

Firm: **Scientific Research Associates, Inc.**
This stand-alone particle-tracking computer code is based upon a Lagrangian analysis in coordinate space combined with a workstation-based user interface. A computed background flow is read as input from a file, and the user specifies particle size, injection location and velocity, drag law, and restitution coefficient via workstation input. Particle size and velocity may be specified deterministically or stochastically. The code calculates and displays the ensemble simulation for particle paths using colored trajectories.

Applications: The software is useful for the design and analysis of solid rocket motors, liquid rocket motors, cavitating pumps, turbomachinery in a dusty environment, fuel sprays, particle separators and is available for lease from Scientific Research Associates.

Contact: Jayant S. Sabnis, Frederick DeJong
203-659-0333

Related SBIR Contracts:
NAS8-37255 MSFC PY 1984 Topic 11
"Internal Fluid Mechanics of Liquid Rockets"

N.07 The FDNS CFD Code

Firm: **SECA, Inc.**

The FDNS CFD code was developed under NASA SBIR to address rocket engine and plume analyses. The FDNS is a Navier-Stokes solver with advanced turbulence and chemical kinetics sub-models. The code is applicable to all flow regimes for both steady and unsteady flows. Both single and multiphase flows are treated.

Applications: The CFD analyses provided by SECA apply to solid and liquid rocket engine performance predictions, to exhaust-plumes, flow-field analyses, and to internal flow predictions of rocket engine systems. Blow-out behavior in combustors is also simulated.

Contact: Richard C. Farmer
205-534-2008

Related SBIR Contracts:
NAS8-38472 MSFC PY 1986 Topic 02
"The Use of Variational Principles in Improving Computational Fluid Dynamics Methodology"

O: Heat Transfer Devices

O.01 High-Heat-Flux, Condensing Heat Exchanger

Firm: **Creare, Inc.**

The condenser uses capillary forces to maintain a thin condensate film and an internal drainage system to remove the liquid from the surface. Heat flux rates of over 60 W/cm²-K and heat-transfer coefficients in excess of 8 W/cm²-K have been demonstrated in water.

Applications: Two-phase space thermal management; thermal management for power systems and process equipment.

Contact: Carolyn Keats
603-643-3800

Related SBIR Contracts:
NAS9-17989 JSC PY 1986 Topic 09
"Low-Film-Resistance Condenser for Operation in a Gravity-Free Environment"

O.02 High-Heat-Flux, Single-Phase Exchanger

Firm: **Creare, Inc.**

This single-phase heat exchanger can achieve heat fluxes comparable to those encountered in evaporating and condensing heat exchangers while maintaining high effectiveness and low

pressure drop. With water as the cooling medium, a prototype heat exchanger achieved a heat flux of 56 w/cm² with an effectiveness of 84 percent and only a 250 Pa (0.04 psi) pressure drop. The same heat flux and effectiveness were achieved with air and a pressure drop of 10 kPa (1.4 psi).

Applications: Spacecraft thermal-management cooling for advanced electronic packaging concepts; cooling of microelectronics or electronics in harsh environments.

Contact: Carolyn Keats
603-643-3800

Related SBIR Contracts:
NAS9-18167 JSC PY 1987 Topic 09
"Compact, High-Performance Heat Exchanger for Space Station"

O.03 Nonazeotropic Heat Pump for Water Heating

Firm: **Foster-Miller, Inc.**

The coefficient of performance (COP) of a heat pump operating between two liquid systems can be increased by greater than 50 percent by using a nonazeotropic refrigerant mixture that exhibits nonisothermal boiling and condensing. Foster-Miller has designed and built an operating prototype for the Space Station Freedom which demonstrates this. Evaporator and condenser efficiency was greatly increased by tailoring the refrigerant's boiling and condensing temperature change to match that of the liquid-side temperature change. This resulted in COPs of 6.5 to 8.5 when tapping a 110°F waste heat source to raise the temperature of hygiene water from 70°F to 140°F. The heat pump utilizes a high-efficiency scroll compressor with an innovative microgravity-compatible lubricating system developed by Foster-Miller.

Applications: This product and its variations can be used to heat water or other liquids in residential or industrial environments and chemical processes. These include a wide range of temperature increases while recovering heat from a wide range of sources. The tools developed for the design of this heat pump can be applied to the design of many systems using nonazeotropic refrigerant mixtures.

Contact: David Walker
617-890-3200

Related SBIR Contracts:
NAS8-38407 MSFC PY 1987 Topic 09
"Nonazeotropic Heat Pump for Crew Hygiene Water Heating"

O.04 Nontoxic, Two-Phase, Heat Transport Fluid

Firm: **Mainstream Engineering Corporation**

Using a computational chemistry system, Mainstream is developing nontoxic heat transport fluids suitable for manned spacecraft habitats. The fluids being developed are nontoxic, nonflammable, inert to the habitat oxidizer, and have suitable thermodynamic performance properties.

Applications: Thermal systems aboard manned spacecraft, potential CFC replacements, other two-phase working fluid applications.

Contact: Lawrence R. Grzyll, Clyde F. Parrish
407-631-3550

Related SBIR Contracts:
NAS9-18471 JSC PY 1990 Topic 09
"Nontoxic Heat Transport fluids for Habitat Two-Phase Thermal Control Systems"

O.05 SCAPE-Suit Heater

Firm: **Mainstream Engineering Corporation**

The SCAPE-Suit Heater is a nontoxic chemical-heating system for use with the propellant handler's ensemble (SCAPE Suit). The SCAPE-Suit Heater heats secondary air that is being circulated within the SCAPE Suit during cold-weather conditions. This heater allows for longer suiting times during these cold-weather periods. The heater unit is designed to be used with the existing SCAPE Suit without modifications.

Applications: This technology could be applied to personal heating of any type, heating of foods and/or beverages, and any other application requiring passive heating.

Contact: Lawrence R. Grzyll
407-631-3550

Related SBIR Contracts:
NAS10-11672 KSC PY 1988 Topic 13
"Improved System for SCAPE Suit Heating"

O.06 Cryogenic Heat Pipe

Firm: **Thermacore, Inc.**

This high-performance, nitrogen/stainless steel heat pipe for operation from 70 K to 100 K. Enhanced performance is obtained by utilizing a high-directional-permeability wick structure made by encasing a narrow gap annulus within a sintered-powder metal matrix. A one-meter long, 1.25 cm OD heat pipe at 80 K demonstrated a thermal

performance of 3.5 watts with 0.4 cm adverse tilt and over 2 watts transport at 2.5 cm adverse tilt. The heat pipe demonstrated reliable start up against gravity while carrying several watts of thermal power. Operation in space is rated at two watt-meters. The purpose of Phase II is to perform a Space Shuttle flight test on this heat pipe design. Phase II started in September 1991.

Applications: Primarily designed for space use, these heat pipes are suitable for cooling infrared sensors and other surveillance detectors. Operation at high power or transport over long distances is possible for maneuvering satellites and space-based platforms. Potential commercial applications include cryogenic and other low-temperature heat pipes capable of operating in vibrating environments and against gravity fields.

Contact: John Rosenfield
717-569-6551

Related SBIR Contracts:
NAS5-31783 GSFC PY 1989 Topic 09
"Sintered-Powder, Artery-Free Wicks for Low-Temperature Heat Pipe"

O.07

HA4 Heat Pipe Cold Plate

Firm: **Thermacore, Inc.**

Thermacore's HA4 Cold Plate provides effective cooling of heat-dissipating electronic components on surface-mounted circuit boards. The reliable performance of the HA4 prevents component overheating that causes component failure. The HA4 utilizes embedded copper/water heat pipes to carry the heat from components to a liquid- or air-cooled cold wall, with a typical center-to-cold-wall temperature difference of 20°C or less. While cooling at both edges is recommended for maximum plate performance, single-edge cooling is possible with a derated performance. The HA4's operation is insensitive to mounting orientation. Each HA4 Cold Plate is individually tested to assure a quality product with long life and high reliability. Dimensions of the HA4 are 9.5" by 4" by 0.12" thick. Its nominal power rating is 50 watts at a maximum temperature difference of 20°C. It weighs only 8 ounces.

Applications: The HA4 modular cold plate is used to cool electronic assemblies and fuel cells. Several thousand have been incorporated into electronics aboard F-15 and F-16 aircraft.

Contact: George Meyer
717-569-6551

Related SBIR Contracts:

NAS9-17610 JSC PY 1984 Topic 09
"Modular Cold Plates for High Heat Fluxes"

O.08

Lightweight Ammonia Heat Pipe

Firm: **Thermacore, Inc.**

This newly developed product is a light-weight heat pipe made from an engineered composite material. The pressure envelope is constructed from an aluminum-foil-lined, carbon fiber/epoxy tube. The thin-walled tube weighs 56 percent less per unit-length than a comparable strength aluminum tube. Burst pressure of the tube is 1750 psi. The heat pipe is designed for operation in the -60 to +60°C temperature range and uses ammonia as the working fluid. The high-performance capillary wick structure is polymer-bonded, aluminum-powder metal with a single artery to facilitate condensate return. To date, heat pipes have been fabricated that are one inch in diameter and two feet long. Estimates based on an all-aluminum version show performance in excess of 50 kW-m.

Applications: Ammonia heat pipes typically find their widest application in spacecraft thermal control. This product is a light-weight alternative to the aluminum/ammonia heat pipes currently being used on NASA, military, and commercial spacecraft.

Contact: Nelson Gauer
717-569-6551

Related SBIR Contracts:
NAS8-38437 MSFC PY 1989 Topic 09
"Composite Material Technology for Lightweight Heat Pipes"

P: Refrigeration and Cryogenics

P.01

Helium Transfer Pump

Firm: **Creare, Inc.**

This transfer pump is designed to pump liquid helium from one tank to another to refill depleted dewars on satellites. The pump is designed to deliver 800 liters per hour of liquid helium against a pressure rise of 2.3 psi. High efficiency results in very small losses of liquid helium.

Applications: To refill dewars on satellites and in laboratories; to pump liquid cryogenics.

Contact: Carolyn Keats
603-643-3800

Related SBIR Contracts:

NAS2-12950 ARC PY 1986 Topic 08
"A Long-Life Centrifugal Pump for Helium II Transfer"

P.02

Joule-Thomson Cryostat

Firm: **General Pneumatics Corporation**

The cryostat is used to liquefy gases through isenthalpic expansion. The expansion orifice is a patented, tapered, annular configuration with contaminant-catchment reservoirs to produce virtually clog-free operation.

Applications: This device may be used in conjunction with bottled gases as an open-cycle device to provide cryogenic cooling for experimental or research processes; heat-treating processes, product development; or operation of infrared sensors, superconducting devices, medical and biomedical apparatus. It may also be coupled with semi-open- and closed-cycle compression and/or pre-cooling systems for the above applications, as well as for reliquefaction of boil-off from cryogen storage dewars.

Contact: Steven G. Zylstra
602-998-1856

Related SBIR Contracts:

NAS10-11322 KSC PY 1984 Topic 11
"Temperature-Sensitive, Variable Area Joule-Thomson Expansion Nozzle and Cryocooler Development."

P.03

Domestic Stirling Cycle Refrigerator

Firm: **Stirling Technology Company**

This product, a domestic Stirling-cycle refrigerator, is based upon technology for Stirling cryocoolers developed in the NASA SBIR program for cooling spacecraft instruments to extremely low temperatures. Demonstration of a prototype for domestic applications is being funded by a Phase II contract with the Department of Energy (DE-FG03-90ER80864). The Stirling heat pump does not use CFCs, is environmentally safe, and presents no fire hazards. The working fluid is helium, which is stable and non-reactive. Disposal of helium at the end of the refrigerator life presents no environmental problems. The Stirling heat pump will offer reliable, low-cost, efficient operation by employing non-contact, flexural bearings with clearance seals for the moving components. STC expects system efficiencies competitive with current CFC-based systems.

Applications: Cryogenic cooling, domestic refrigeration, and other heat pump or refrigeration applications.

Contact: Peter Riggle
509-375-4000

Related SBIR Contracts:

NAS5-31176 GSFC PY 1988 Topic 07
"Stirling Cryocooler with Extremely Low Vibration"

P.04

Long Life Cryocoolers

Firm: **Stirling Technology Company**

Cryocoolers for focal plane arrays or other sensors; very long maintenance-free life (5-15 years); very low vibration; high efficiency.

Applications: Spacecraft cryocooling; terrestrial cryocooling; specialty compressors-absolutely contamination-free.

Contact: Peter Riggle
509-375-4000

Related SBIR Contracts:

NAS5-31176 GSFC PY 1988 Topic 09
"Stirling Cryocooler with Extremely Low Vibration"

Q: Energy Conversion Devices

Q.01

Pyroelectric Converter

Firm: **Chronos Research Laboratories, Inc.**

This pyroelectric converter transforms heat directly into electrical energy. It provides an inexpensive (cheaper than utility wholesale rates) means of generating electricity from a variety of low temperature sources including: industrial reject-heat, geothermal heat, and even solar heat. This patented technology will be made available for licensing for a limited time in the United States.

Applications: Generation of electricity from several possible heat sources including geothermal, industrial, solar, and ocean thermal gradient.

Contact: Randall B. Olson
619-455-8200

Related SBIR Contracts:

NAS7-998 JPL PY 1985 Topic 09
"Pyroelectric Belt Radiator"

Q.02

ReLi® Rechargeable Lithium Cells and Batteries

Firm: **EIC Laboratories, Inc.**

The ReLi® cell is a secondary lithium cell that has three times the energy density of NiCd cells. The nominal output voltage is 2.1 V, and the nominal

capacity of an AA cell is 1 Ahr. The cell is capable of >300 cycles and will deliver 65 percent of its capacity at over 2 V providing 300 mA continuously. After 350 cycles the cell can still deliver 65 percent of its capacity at over 1.7 V as a series of 2-amp pulses with a 150-msec duration. At lower currents, almost 100 percent of the cell's capacity can be delivered at >2 V.

Applications: These cells can be used as AA cells or assembled into 9 V prismatic cells for use in portable computers, portable telephones, portable sensing equipment, flashlights, hand-held tools, and camcorders. One cell can keep 2 V memory circuitry working.

Contact: Dennis N. Crouse
617-769-9450

Related SBIR Contracts:
NAS7-1100 JPL PY 1988 Topic 10
"Long-Cycle-Life, Rechargeable Lithium Batteries"

Q.03

Composite-Matrix Regenerators for Stirling-Cycle Engines

Firm: **Energy Science Laboratories, Inc.**

The product line is light-weight, high-performance, regenerative heat exchangers for use in Stirling-cycle engines and coolers. Carbon-fiber composite design permits tailoring the regenerator thermal-hydraulic characteristics to meet specific requirements. High-conduction anisotropy, low-pressure drop, enhanced heat capacity, low thermal expansion, and high-temperature stability are advantages over conventional metallic regenerators.

Applications: Regenerative heat exchangers for Stirling-cycle engines, heat pumps, and coolers. Low-cost microcooler design. Stationary and rotary regenerators for use in recuperated turbine systems.

Contact: Timothy R. Knowles
619-552-2034

Related SBIR Contracts:
NAS3-26279 LeRC PY 1989 Topic 10
"Composite Regenerator for Stirling Engine"

Q.04

Chemical/Mechanical Heat Pump

Firm: **Mainstream Engineering Corporation**

The chemical/mechanical heat pump is an innovative, high-reliability, high-efficiency heat pump for attachment to a spacecraft thermal bus. The heat pump allows equipment to operate at a temperature colder than the saturation tempera-

ture of a two-phase thermal bus. The heat pump combines the advantages of a mechanical vapor compression heat pump with those of chemical heat-pump systems.

Applications: This product has many applications, ranging from spacecraft thermal management to terrestrial heat pumps. High-speed, high-efficiency, high-reliability compressor and pump is also being developed that has many fluid-handling and thermal-management applications.

Contact: Muhammad Rahman, Lawrence R. Grzyll
407-631-3550

Related SBIR Contracts:
NAS5-31167 GSFC PY 1988 Topic 09
"Modular Chemical/Mechanical Heat Pump for Spacecraft Thermal Bus Applications (Phase II)"

Q.05

Ultra-Lightweight, All-Metal Mirror Facet for a Solar-Dynamic Power System

Firm: **Solar Kinetics, Inc.**

Solar Kinetics has developed a scaled parabolic mirror facet for a 2-meter solar-dynamic concentrating power system. This mirror has an all-metal honeycomb construction with a specific weight of 1.8 kg/m². The specular reflectivity has an rms value greater than 85 percent within a 4-milliradian cone angle of 632 nm. The optical surface performance is achieved by application of leveling, reflective, and protective coats. A surface-slope accuracy of better than 1 milliradian is achieved. Currently, a 1-meter, triangular mirror facet is being developed for the Space Station program.

Applications: Terrestrial and space reflectors and concentrators for solar dynamic power generation and lightweight antenna dishes.

Contact: Shabbar Saifee
214-556-2376

Related SBIR Contracts:
NAS3-25632 LeRC PY 1987 Topic 10
"An Improved Mirror Facet for Space Applications"

R: Oceanographic Instruments

R.01

PNF-300 Profiling Natural Fluorometer

Firm: Biospherical Instruments, Inc.

Natural fluorescence is the solar-stimulated fluorescence of chlorophyll-a in the phytoplankton crop, and is easily measurable throughout the euphotic zone even in the most oligotrophic waters. The PNF-300 uses this newly identified optical signal to measure both growth photosynthetic rate and chlorophyll-a concentration within the water column. Using the latest advances in integrated circuits and optical design, this compact instrument measures a wide variety of physical and biological variables: natural fluorescence (upwelled radiance at 683 nm), scalar irradiance (photosynthetically active radiation or PAR), computed primary production and chlorophyll-a concentration, temperature, and pressure/depth. The instrument is self-contained and compact enough to be deployed by hand from vessels as small as skiffs and inflatables. A surface scalar irradiance sensor (over PAR) is also included. In addition to their use for profiling, the signals from these sensors can be integrated or averaged over periods controlled by the user.

Applications: The PNF-300 can be used whenever instantaneous measurements of natural fluorescence, downwelling irradiance, temperature, and computed primary production of chlorophyll-a concentration are desired. Typical applications include oceanographic and biological research, as well as water quality monitoring. In addition to its profiling capabilities, the PNF-300 can be used when the time series of PAR and natural fluorescence is desired, such as to support measurements of photosynthesis using oxygen evolution or ^{14}C incorporation.

Contact: John H. Morrow
619-270-1315

Related SBIR Contracts:

NAS7-969 JPL PY 1984 Topic 08
"Measurement of Chlorophyll, Related Pigments, and Productivity of the Sea"

R.02

MER-2020 Oceanographic Instrument

Firm: Biospherical Instruments, Inc.

BSI's MER-2020 represents a new type of oceanographic instrument allowing unattended monitoring of biological and optical variables over periods of up to several months. This instrument, ideal for installation on moorings or drifters, allows long-term monitoring of bio-optical variability in oceanic environments. The system features five channels of downwelling irradiance, five channels of

upwelling radiance, temperature, two-axis tilt and roll, pressure (depth), battery voltage, and date/time. Both the downwelling irradiance and upwelling radiance detectors are composed of individual arrays of detectors, each at different wavelengths, with three cavity interference and blocking filters. Each sensor uses a dedicated amplifier tuned to provide maximum usable dynamic range at its particular wavelength. The MER-2020 can also be equipped with optical detectors to measure natural fluorescence, the solar-stimulated fluorescence of chlorophyll used to predict instantaneous, gross primary production in phytoplankton. Data are recorded initially in 448 kB of RAM and transferred to a 40 MB tape with an additional 20 MB of redundant memory with error-correcting capability. This translates to over 100,000 complete sensor scans with full statistics: for example, an observation set every two minutes for 150 days. In addition to direct optical measurements at a variety of wavelengths, the MER-2020 provides measurements of spectral radiance (optionally, irradiance), reflectance, and when used in tandem, spectral-diffuse attenuation coefficient.

Applications: Typical applications of the MER-2020 include oceanographic and biological research, including remote-sensing programs such as satellite ocean-color ground truth, long-term monitoring of optical and bio-optical variability, and studies using bio-optical moorings or drifters.

Contact: John H. Morrow
619-270-1315

Related SBIR Contracts:

NAS7-934 JPL PY 1983 Topic 08
"Moored Oceanographic Spectroradiometer"

R.03

AOCI

Firm: Daedalus Enterprises, Inc.

This airborne imaging spectrometer is interchangeable with other spectrometers that use a Daedalus Model AB122 scan head and electronics package.

Applications: The AOCI has been developed to study biomass, chlorophyll content, and temperature, especially in offshore waters. It has been observed that the most probable location of large schools of fish can be determined when the physical properties of the waters can be defined.

Contact: Keith A. More
313-769-5649

Related SBIR Contracts:

NAS2-12116 ARC PY 1983 Topic 08
"Design, Fabricate, and Test an Airborne Ocean
Color Imager (AOCI)"

S: Atmospheric Monitoring Devices

S.01

Atmospheric Trace Gas Fluxmeter

Firm: **Aerodyne Research, Inc.**

This instrument is designed to measure the production rates or surface fluxes of atmospheric trace gases such as methane and nitrous oxide, in order to characterize their sources and sinks. The method is based on the eddy correlation technique and uses a tunable diode laser-infrared light source combined with a unique open-path multiple-pass absorption cell for trace gas detection at the sub-ppb level.

Applications: Atmospheric chemistry research in biogenic trace gas flux measurements such as methane (CH₄) and nitrous oxide (N₂O); agricultural research; global-warming greenhouse gas research; tropospheric chemistry research.

Contact: Mark S. Zahniser
508-663-9500

Related SBIR Contracts:

NAS2-12433 ARC PY 1984 Topic 12
"An Open Path Diode Laser Absorption Instrument for
Flux Measurements of Biogenic Trace Gases"

S.02

Wildfire

Firm: **Daedalus Enterprises, Inc.**

This airborne infrared imaging spectrometer is interchangeable with other spectrometers that use the Daedalus AB122 scan head and electronics package.

Applications: Wildfire was developed for the study of the gases evolved, the nutrient transport, and the thermal profile of wildfires. Wildfire, an infrared imaging spectrometer, can also be applied to geologic and environmental studies.

Contact: William T. Baker
313-769-5649

Related SBIR Contracts:

NAS2-13036 ARC PY 1986 Topic 08
"An Airborne Multispectral Scanner to Measure Fire,
Terrestrial and Atmospheric Characteristics-50
Channel"

S.03

200 MHz Surface Acoustic Wave Aerosol Particle and Chemical Vapor Sensor

Firm: **Femtometrics**

The piezoelectric-crystal, mass microbalance acts as a microgravimetric sensor as small changes in the mass on the surface of the crystal detune its oscillation. The change in frequency is proportional to the change in mass. The mass sensitivity is a function of the square of the operating frequency. Small increases in operating frequency give large increases in sensitivity. A 10 MHz bulk crystal has a mass sensitivity of 1.5 Hz/nanogram. Femtometrics has developed a 200 MHz surface acoustic-wave (SAW), piezoelectric, mass microbalance with a mass sensitivity of 1 Hz/picogram.

Applications: The SAW microbalance can be used in most applications where conventional bulk crystals are used. This includes the collection and mass determination of aerosols on its surface. Coating the SAW microbalance with a selective chemical allows detection of gas vapor.

Contact: William D. Bowers
714-722-6239

Related SBIR Contracts:

NAS1-18653 LaRC PY 1986 Topic 08
"High-Sensitivity Particle and Gas Instrument Using the
Acoustic-Wave Piezoelectric Crystal"

S.04

A Non-Optical, Real-Time Particle Fallout Monitor

Firm: **Femtometrics**

A vertical elutriator is used to reject fallout particles smaller than a specified size, and a quartz crystal piezoelectric microbalance is used to collect and detect the size segregated fallout. The instrument operates in real time with the change in frequency proportional to the mass of the particle.

Applications: The real-time particle fallout monitor could be used in the aerospace industry to monitor the size and number of particles falling on a payload's surface prior to launch. Other uses include the monitoring of specific size bands of particles for health and safety reasons in industrial manufacturing.

Contact: William D. Bowers
714-722-6239

Related SBIR Contracts:

NAS10-11651 KSC PY 1989 Topic 13
"A Real-Time Particle Fallout Monitor"

S.05

Space Particulate Imaging Measurement Sensor

Firm: SKW Corporation

The Space Particulate Imaging Measurement Sensor (SPIMS) system is intended to provide low-cost, real-time data on the ambient particulate contamination present in space, vacuum, or ambient environments. In addition, the SPIMS sensor is also suited for in-process measurement of cross-section or diameter with an accuracy of ± 5 microns. Each sensor or laser imager module (LIM) can operate independently or be tied to a data server or command data handler (CDH). Each LIM detects, images, and sizes the particles present in a free-space detection zone. The sizes are "binned" with a total measurement range of less than 5 microns to over 1000 microns. The system uses a 670 nm laser-diode illumination source and a linear CCD array. A "bar" filter is used for obscuring the laser beam and generating a background against which particles are measured and detected. Real-time image processing is done within the LIM to provide particle measurements as a serial data stream. The data from the SPIMS system can be adapted to the user's choice of data bus/storage or display device.

Applications: SPIMS can be used in any environment: microgravity, vacuum, or ambient. It can be used where the continuous monitoring of particulates is required in a gas flow or in static environments.

Contact: Scott Bartel
714-361-5660

Related SBIR Contracts:
NAS5-30636 GSFC PY 1987 Topic 08
"A Free Space Particulate Contamination Sizing/Counting System for Space Applications"

S.06

Cloud Top Radiometer

Firm: Space Instruments, Inc.

The Cloud Top Radiometer (CTR) is a passive instrument that can measure cloud-top altitudes continuously from a single geostationary platform at a sufficiently high repetition rate to continuously watch for severe storms. The CTR utilizes the oxygen A-band technique with several different absorption channels to optimize performance. The CTR design eliminates scanning and complex cryogenic systems by use of an uncooled silicon CCD area-array camera. The staring array allows a long integration time, which produces a high SNR even at geostationary altitude. By operating in the visible region, the altitude measurements are independent of temperature and emissivity variations within the cloud. A linear dynamic

range much larger than that possible within the CCD wells is obtained by means of a digital accumulator to cover all possible cloud and atmospheric conditions. A filter wheel allows a single detector array to make measurements at all wavelengths, thus assuring excellent calibration between wavelength measurements.

Applications: Prior to the outbreak of many severe thunderstorms, overshooting cloud tops rise at a very rapid rate. The vertical updraft rate of the cloud tops can therefore be used as an indicator of potential severe storms and tornadoes. Lead times of 14 minutes for storms and 25 minutes for tornadoes have been measured.

Contact: James W. Hoffman
619-944-7001

Related SBIR Contracts:
NAS5-30846 GSFC PY 1989 Topic 08
"Cloud Top Radiometer"

S.07

Raman Gas-Monitoring System

Firm: Spectral Sciences, Inc.

The Spectral Sciences, Inc. Raman Gas Monitoring System is a patented, optical gas sensor featuring rapid, linear response, background independence and a rugged, vibration-resistant design. A prototype system, HLMS, has been built for hydrogen leak detection during launches of the Space Shuttle, and has a H_2 sensitivity of 100 ppmv.

Applications: H_2 leak detection; other gas concentration monitoring applications (O_2 , N_2).

Contact: Steven Adler-Golden
617-273-4770

Related SBIR Contracts:
NAS10-11514 KSC PY 1986 Topic 13
"Hydrogen Laser Monitoring System"

S.08

Advance Warning Airborne System

Firm: Turbulence Prediction Systems

The advance warning airborne system (AWAS) is a passive infrared spectrometer that provides a 20 to 60 second warning of low-level wind shear (LLWS) and a 4 to 6 minute warning of high-altitude clear-air turbulence (CAT). The AWAS weighs about 9 pounds and is 6" x 7" x 9". The system uses 28 Vdc at 1.0 amperes.

Applications: Detection of LLWS and CAT in advance. It may also be used for detection of volcanic ash and wake vortices and as a ground sensor for temperature and humidity.

Related SBIR Contracts:

NAS1-18854 LaRC PY 1987 Topic 03
"Advance Warning Airborne System (AWAS)"

S.09

Thermally Desorbable Toxin and Odor Control Cartridge

Firm: **Umpqua Research Company, Aerospace Division**

Multi-media layered adsorbent beds have been developed as an effective means of removal of mixtures of toxic and odor-causing organic molecules from spacecraft air streams. The adsorbent beds are regenerated in situ by thermal desorption of the adsorbed vapors. Advantages over use of activated charcoal adsorption include enhanced contaminant removal efficiency in humid air; significantly reduced hardware volume; minimization of resupply expendables; reduction of manhours required for system maintenance; and more effective removal of a wider variety of contaminants.

Applications: This technology can be used to solve a broad spectrum of industrial and commercial airborne contaminant control problems, ranging from purification of gaseous effluent streams to remediation of sick-building syndrome.

Contact: James E. Atwater
503-863-7770

Related SBIR Contracts:

NAS9-18337 MSFC PY 1989 Topic 12
"Thermally Desorbable Toxin and Odor Control Cartridge"

S.10

Pilot Weather Advisor

Firm: **ViGYAN, Inc.**

The Pilot Weather Advisor processes weather and radar information from commercial vendors in real time. The processed information is then broadcast via satellite to aircraft. When received by the aircraft, the information is decoded and graphically displayed on a color monitor for the pilot's use.

Applications: Real-time weather/radar for aviation use; for on-the-ground preflight briefing and inflight weather monitoring.

Contact: W. Allen Kilgore
804-865-1400

Related SBIR Contracts:

NAS1-19250 LaRC PY 1990 Topic 03
"Pilot Weather Advisor"

T: Water Management

T.01

Process-Control Water Quality Monitor

Firm: **Astro International Corporation**

The product is a new instrument for continuous on-line measurement for total organic carbon, biocide, pH, conductivity and turbidity of the quality of effluent process water.

Applications: Water quality analysis for waste water and in-process monitoring.

Contact: Robert Ashcraft
713-332-2484

Related SBIR Contracts:

NAS9-17612 JSC PY 1984 Topic 12
"Reagentless Water Quality Monitor"

T.02

Prototype Membrane-Based Wash-Water Recovery Unit

Firm: **Bend Research, Inc.**

The Prototype Membrane-Based Wash-Water Recovery Unit is a two-stage system utilizing fouling-resistant, ultrafiltration modules in the first stage to remove macromolecules (e.g., soap) and suspended solids, and a spiral-wound RO module in the second stage to remove low-molecular-weight species (e.g., organics, salts). The unit is designed to recycle at least 90 percent of the wash water, producing recovered water suitable for reuse as wash water.

Applications: Additional commercial applications for the unit include the recycle and reuse of laundry waste water, car-wash waste water, and dishwasher waste water.

Contact: Scott B. McCray
503-382-4100

Related SBIR Contracts:

NAS9-17031 JSC PY 1983 Topic 12
"Novel Reverse-Osmosis Module for Spacecraft Wash-Water Recycle"

T.03

Catalytic Oxidizer for Treatment of Aqueous Wastes

Firm: **Umpqua Research Company**

This process is used to oxidize a wide variety of organic contaminants in an aqueous stream to their constituent gases (i.e., CO₂ and H₂O). The system operates at a low temperature, between 75° and 125°C. The oxidant used is molecular oxygen, which can be introduced into the system

via a membrane saturator. The saturated aqueous steam is then fed into a catalytic reactor that is maintained at the desired temperature. Upon passage over the catalyst, a wide variety of organic waste contaminants are oxidized completely to their component gases. The waste gases are then removed downstream by a membrane gas/liquid separator. Total organic carbon levels in the low ppb range are achieved by this system.

Applications: Organic contaminant removal for water purification; ultrapure water production.

Contact: Clifford D. Jolly
503-863-7770

Related SBIR Contracts:
NAS8-38490 MSFC PY 1988 Topic 12
"Catalytic Methods Using Molecular Oxygen for Treatment of PMMS and ECLSS Waste Streams"

T.04

Electrochemical Water Treatment Device and Process

Firm: **Umpqua Research Company**

The Electrochemical Water Recovery (EWR) technique as applied to waste water containing percent-level contaminants is a two-step process. The organic components present are first electro-oxidized to their constituent gases. In the second step the remaining inorganic species and ionizable organic species are removed by electrodialysis. The Phase I study demonstrated that these processes can be operated in a coordinated fashion wherein electro-oxidation is stopped before unwanted products are formed. This methodology results in an energy-efficient treatment. It produces sterile, relatively pure water with between 98 and 99 percent of the organics and greater than 99.9 percent of the inorganic species removed. Potable water can be produced from this product with a minimal expenditure of additional power by using photoelectrolysis or other post-treatment. The application of such a process, which uses no expendables, is particularly attractive for long-duration space missions. In such missions, resupply is impractical, and the recovery of water from onboard waste streams is mandatory.

Applications: As the discharge of untreated wastes into marine and inland waterways by pleasure craft and commercial vessels comes under closer scrutiny, some sort of treatment and/or holding tank for later onshore discharge is necessary. EWR technology provides a convenient treatment method that can sterilize such effluents, reduce their organic loads to less than 100 mg/liter, and decrease the residual that must be stored to 10 percent of the original volume.

Contact: James R. Akse
503-863-7770

Related SBIR Contracts:
NAS9-18528 MSFC PY 1989 Topic 12
"Electrochemical Water Recovery Process for Treatment of Urine and Other Biological Waster Streams"

T.05

Enzyme-Based Heterogeneous Oxidation Catalyst

Firm: **Umpqua Research Company**

An immobilized alcohol oxidase enzyme-based catalyst has been developed that displays very-long-duration operational activity compared to the free enzyme. Fixed bed reactors incorporating the catalyst have been designed and used for oxidation and subsequent removal of a variety of alcohols, glycols, and aldehydes from aqueous streams. The catalyst operates at ambient temperature and requires no energy. The catalyst is stable; virtually no secondary contamination of the water stream is observed. The catalyst and catalyst cartridges can be delivered sterile.

Applications: Production of aldehydes from alcohols, alcohol removal, analysis of alcohols and/or aldehydes in biological or process samples.

Contact: Clifford D. Jolly
503-863-7770

Related SBIR Contracts:
NAS8-38421 MSFC PY 1987 Topic 12
"Biocatalytic Reactors for Removal of Volatile Contaminants from PMMS, ECLSS and Life Sciences Waste Water"

T.06

Flow-through Device for Acid Gas Removal From Aqueous Solution

Firm: **Umpqua Research Company**

The product removes acid gases and their hydrolysis products from aqueous solution. It is a flow-through device consisting of a solid-phase, fixed bed acidification module integrated with a membrane gas/liquid separator in the hollow fiber, flat sheet or spiral wound configuration. The acidification module imparts a known level of acidity to a process stream. For example, a solution containing bicarbonates and/or carbonates is passed through the acidification module, converting all inorganic carbon species to dissolved CO₂ which is subsequently removed by the membrane separator.

Applications: Inorganic carbon removal from aqueous solution, removal of SO₂, NO_x and their hydrolysis products, controlled acidification of process streams or batch reactions without requiring chemical feed pumps and tanks.

Contact: Clifford D. Jolly
503-863-7770

Related SBIR Contracts:
NAS8-38460 MSFC PY 1989 Topic 12
"A Reagentless Separator for Removal of Inorganic Carbon from Solution"

T.07

Immobilized Urease Catalyst, Urea and Nitrogen Removal Cartridges

Firm: Umpqua Research Company

The enzyme urease is available as an immobilized, insoluble catalyst. The material catalyzes the hydrolysis of urea to ammonia and carbon dioxide at room temperature. The material is highly active and has operational activity for many months and possibly longer, depending on the application. The catalyst is very clean, contributing virtually no secondary contamination to a water stream or sample. Fixed bed reactors incorporating the immobilized urease are used to remove urea and its decomposition products from process water. The catalyst and reactor cartridges can be delivered sterile.

Applications: Kidney dialysis equipment, urea analysis, wastewater treatment, and urea removal.

Contact: Clifford D. Jolly
503-863-7770

Related SBIR Contracts:
NAS8-38421 MSFC PY 1987 Topic 12
"Biocatalytic Reactors for Removal of Volatile Contaminants from PMMS, ECLSS and Life Sciences Waste Water"

T.08

Regenerable Microbial Check Valve

Firm: Umpqua Research Company

A self-contained, fully automated system has been developed for the controlled delivery of molecular iodine to a flowing water stream to prevent microbial growth. The system uses an iodinated polymer to impart a nominal 2 mg/l I₂ to the aqueous medium by equilibrium partitioning. Upon depletion, the polymer is reiodinated in situ without interruption of flow. Advantages of the system include minimization of human interaction required for operation, minimization of system

maintenance needs, and dramatic reduction in required resupply expendables.

Applications: This technology can be applied to the treatment of potable waters for prevention of growth of pathogenic micro-organisms. The system can also be used with industrial aqueous process streams to prevent bio-fouling.

Contact: James E. Atwater
503-863-5201

Related SBIR Contracts:
NAS9-18361 MSFC PY 1988 Topic 12
"Regenerable Biocide Delivery Unit"

U: Life Science Instruments

U.01

FlurO₂

Firm: BioChem Technology, Inc.

FlurO₂ emulsions are disposable, stabilized emulsions used as an additive for culture media. The advantages are twofold: (1) Enhanced oxygen supply - The PFC particles act as oxygen suppliers to surrounding cells grown in the aqueous phase. FlurO₂ Emulsions used as a media additive in a ratio of 10 percent by volume have dramatically increased the oxygen supply capacity of bioreactors. Results on hybridoma (ATCC HB32) cultures in rotated cell culture tubes have increased maximum live cell density by approximately 80 percent. (2) Better cell suspension - Settling problems lead to uneven distribution and inefficient utilization of bioreactor capacity and/or other damage from cell accumulation on the bottom of the bioreactor. FlurO₂ emulsions, when mixed with culture media, can be matched to the density of cells and microcarriers to reduce the amount of agitation required to keep the cells in suspension.

Applications: Media supplement for cell culture.

Contact: William B. Armiger
215-768-9360

Related SBIR Contracts:
NAS9-17812 JSC PY 1985 Topic 15
"Use of Liquid Carriers in Tissue Culture for Aeration"

U.02

CDDP Non-Invasive Hemodynamic Patient Management System

Firm: BoMed Medical Manufacturing, Ltd.

The BoMed CDDP (CardioDynamic Data Processing) System is a non-invasive hemodynamic patient management system consisting of a personal computer with a printer, proprietary CDDP soft-

ware, and two noninvasive hemodynamic monitors: BoMed's NCCOM3-R7, an electrical bio-impedance-based device for measurement of blood flow and left-ventricular performance parameters (developed under SBIR Contract NAS9-17809), and Critikon's Dinamap, or a similar device, for measurement of blood pressure. The patient data are available in two formats: (a) monitoring, providing a complete definition of the patient's hemodynamic state (status of 11 hemodynamic parameters in respect to their normal ranges), and (b) therapeutic, defining the deviations in volume, inotropy, chronotropy and vasoactivity, which are responsible for observed abnormal hemodynamic state.

Applications: Non-invasive real-time management of inpatients, outpatients and pacemaker patients, and in sports medicine.

Contact: Hevka Sramek
714-770-5322

Related SBIR Contracts:
NAS9-17809 JSC PY 1985 Topic 12
"Continuous Non-Invasive Determination of Ventricular Parameters"

U.03 PaceMate

Firm: **BoMed Medical Manufacturing, Ltd.**
BoMed CDDP PaceMate System (CDDP System expanded by a PaceMate module) is used to manage patients with pacemakers. Independent of the number of chambers paced or the pacemaker manufacturer. The system enables rapid setting of a heart rate and atrio-ventricular delay to produce an optimal hemodynamic state.

Applications: Optimal pacemaker performance setting.

Contact: Hevka Sramek
714-770-5322

Related SBIR Contracts:
NAS9-17809 JSC PY 1985 Topic 12
"Continuous Non-Invasive Determination of Ventricular Parameters"

U.04 Fiber-Optic pH Optrode and Electronics Interface

Firm: **Geo-Centers, Inc.**
The product consists of a pH optrode (fiber-optic chemical sensor) and its support electronics. This system offers small sensor size, electromagnetic interference immunity, and less interference from the effects of solution flow and conductivity.

Applications: The pH measurement system has been designed to support NASA plant-growth experiments. When interfaced with NASA control systems this measurement system becomes part of a system to actively control nutrient-solution pH. It will also find use in other agricultural applications, environmental monitoring, and controlling a variety of chemical and industrial processes.

Contact: Bruce N. Nelson
617-964-7070

Related SBIR Contracts:
NAS10-11671 KSC PY 1988 Topic 12
"Optrode Development for Environmental pH Monitoring - Phase II"

U.05 Calorimeter and Waste Management System

Firm: **GeoScience Limited**

A direct animal calorimeter system to monitor metabolic heat releases from animals in space has been designed, fabricated, and tested in the laboratory and during KC-135 parabolic, zero-gravity flights. The system does not require the monitoring of CO₂, O₂ and water vapor concentrations and their flow rates. The direct calorimeter measures all the radiant energy lost by the animal as well as part of its convective heat loss. Mini-psychrometers measure the remaining convective heat loss from the animal in addition to the total evaporative heat loss. A flowmeter determines the ventilating air-flow rate through the calorimeter. Geoscience has also developed a special waste removal and storage system. It consists of a high velocity air blower, inlet and outlet air valves that are actuated by controlled motors, and a waste separation and storage system for the feces and urine.

Applications: This system can be used to obtain metabolic heat releases (and the radiative, evaporative, and convective components) during space missions. The current complete calorimeter system has been designed to fit into a double, mid-deck locker on the Shuttle.

Contact: Heinz F. Poppendiek
619-755-9396

Related SBIR Contracts:
NAS2-12638 ARC PY 1985 Topic 12
"Calorimeter and Waste Management System"

U.06

Variable-Speed Mid-Deck Centrifuge

Firm: **Micro-G Research, Inc.**

The variable speed mid-deck centrifuge is, as its name suggests, a prototype for a flight unit designed to fit in the volume occupied by two shuttle middeck lockers. It is a twin-rotor centrifuge device capable of providing programmable g-force stimuli within the range 0.05 to 1.1 g to biological and other specimens. Specimens can be recorded by infrared-sensitive video cameras during rotation. The image data is compressed and stored on floppy disks for later analysis. The rotor compartment is temperature controlled to $\pm 0.4^\circ\text{C}$. Slip ring connections are provided for power, data, and signal lines.

Applications: Research tool for biologists and physical scientists conducting research over a range of g-levels from zero to a value somewhat above earth's gravity.

Contact: David K. Chapman
215-387-9339

Related SBIR Contracts:

NAS10-11404 KSC PY 1985 Topic 12
"Variable Speed Mid-Deck Centrifuge"

V: Spacecraft Electromechanical Systems

V.01

T-Reaction Wheel

Firm: **Ithaco, Inc.**

The momentum and reaction wheel contains an aluminum flywheel suspended on ball bearings and driven by an ironless-armature, brushless DC motor. Optimum power efficiency and maximum inertia-to-weight are realized with the large diameter motor components. The symmetrical housing provides dual mounting surfaces to allow the addition of the T-SCANWHEEL optics module and to expand mounting options on the spacecraft. Increased momentum capacity or redundancy can be obtained by bolting two assemblies together.

Applications: The T-Reaction Wheel is a fully capable momentum/bi-directional reaction wheel built specifically for small satellites. It is used for both three-axis reaction control and momentum-biased systems. The T-Reaction Wheel is unique because it can be used as a stand-alone momentum and reaction wheel or augmented with horizon-sensor optics to provide both attitude determination and angular momentum and control torque.

Contact: Richard G. Burton
607-272-7640

Related SBIR Contracts:

NAS5-30307 GSFC PY 1986 Topic 09
"Low-Cost Attitude Control System"

V.02

T-SCANWHEEL

Firm: **Ithaco, Inc.**

The T-SCANWHEEL is a momentum and reaction wheel with an integral, high-accuracy, conical earth sensor. The scanwheel provides both angular momentum and control torque while the conical earth sensor obtains precise attitude information. T-SCANWHEELS are employed on either two- or three-axis stabilized spacecraft where their unique combination of attitude sensing and control capability reduces overall system cost, minimizes weight, and affords an order of magnitude reduction in power consumption.

Applications: A common application of the T-SCANWHEEL is to replace the earth sensor and the momentum and reaction wheel in a momentum-biased attitude control system. By aligning the T-SCANWHEEL spin axis with the spacecraft pitch axis, gyroscopic stiffness in roll and yaw is provided. A simple, pitch-lead lag-loop controls the T-SCANWHEEL speed so that the spacecraft remains aimed at the earth.

Contact: Richard G. Burton
607-272-7640

Related SBIR Contracts:

NAS5-30088 GSFC PY 1985 Topic 09
"Full Sky Scanner"

V.03

Active Magnetic Micro-Gravity Isolator for Space Station

Firm: **SatCon Technology Corporation**

This product is a vibration isolation system used to isolate the experimental payloads from Inherent Space Station vibrations. The vibration requirements are met by an active isolation system that has the capability to adjust to differing vibration environments, changes in payloads, and changes in desired isolator dynamics. This magnetic suspension is an extremely promising approach to implementing these active isolation systems. Its desirable characteristics include high bandwidth, linearity, stability, high efficiency, multi-axis capability, and ease of integration with electronic control systems.

ease of integration with electronic control systems.

Applications: Semiconductor crystal growing isolation, pharmaceutical culture isolation, optical isolation and pointing.

Contact: Ralph C. Fenn
617-661-0540

Related SBIR Contracts:
NAS8-38418 MSFC PY 1987 Topic 15
"Active Magnetic Micro-Gravity Isolator for Space Station"

V.04

Superconducting Large-Angle Magnetic Suspension

Firm: **SatCon Technology Corporation**

This product is an advanced control moment gyro (CMG) type of momentum-exchange actuator sized for large spacecraft slew maneuvers. The key component of the CMG is a magnetic suspension system which combines the functions of conventional rotor bearings and mechanical gimbals. This product meets the needs of a demanding slew maneuver by incorporating a superconducting magnet. This product consists of a superconducting solenoid ("source coil") suspended within an array of non-superconducting coils ("control coils"), a five-degree-of-freedom position sensing system, switching power amplifiers, and a digital system.

Applications: Mirror pointing mount, telescope pointing mount, advanced control moment gyroscope (CMG), solar array gimbal, antenna gimbal.

Contact: James R. Downer
617-661-0540

Related SBIR Contracts:
NAS1-18853 LaRC PY 1987 Topic 09
"Superconducting Large-Angle Magnetic Suspension"

V.05

An Integrated Micro-Gyroscope

Firm: **SatCon Technology Corporation**

This micro-mechanical gyroscope is a device consisting of an electrically suspended, spinning rotor and integrated control and interface electronics. It provides linear and angular rate measurements in a small, low-power package.

Applications: The devices could be produced for low cost in large quantities and could see

widespread use in integrated navigation and control systems for vehicles, personnel, or projectiles. A micro-gyroscope might also make possible very small autonomous airplanes, ground vehicles, or satellites for terrestrial, planetary, or space exploration.

Contact: Richard L. Hockney
617-661-0540

Related SBIR Contracts:
NAS1-19282 LaRC PY 1990 Topic 05
"An Integrated Micro-Gyroscope"

Addendum to H: Optical Devices and Lasers

H.11

Acousto-Optic Tunable Filters

Firm: **AOTF Technology, Inc.**

An Acousto-optic tunable filter is a solid-state optical filter. The spectral bandpass of the filter can be tuned by changing the frequency of the applied R.F. signal. The AOTF functions as an electrically tuned optical filter, with a range from ultraviolet to infrared. (120 nm. to beyond 10 μ m.) The AOTF has the ability to operate in sequential and multiwavelength modes.

Applications: Ideal for space-based applications because of its small size, reliability, fast switching time and it has no moving parts. Often used in optical equipment such as: microscope and telescope spectrometers. AOTF devices can be used to upgrade existing equipment which used mechanically tuned systems.

Contact: Patrick Katzka or Crista vanSandwijk
408-734-5435

Related SBIR Contract(s):
NAS7-1112 JPL PY 1988 Topic 08
"AOTF Enhancements for a Space-Based Spectropolarimeter"

FIRMS

The NASA SBIR participants who have submitted information for this catalog are listed below in alphabetical order. The listing gives the firms' own definitions of the nature of their businesses along with the names of company officials. The entries include the names and identifying numbers of the products described in this catalog.

Accurate Automation Corporation

1548 Riverside Drive, Suite B
Chattanooga, TN 37406

Accurate Automation Corporation specializes in the design and development of systems using neural network technology. These systems include control applications like robotics and avionics. Other applications include radar, signal processing, sensor fusion, and fault diagnosis with neural networks.

Contact: Robert M. Pap
615-622-4642

Product(s) Described:

B.01: Neural Net Toolbox

Advanced Decision Systems

1500 Plymouth Street
Mountain View, CA 94043-1230
(Note: The firm is now a division of Booz, Allen & Hamilton, Inc.)

The firm provides "high-end" information processing technologies, services, and products that address problems of national importance.

Contact: Barry M. Leiner
415-960-7557

Product(s) Described:

C.01: Reactive Planning for EVA retriever

Advanced Research and Applications Corporation

425 Lakeside Drive
Sunnyvale, CA 94086-4701

Advanced Research and Applications Corporation (ARACOR) founded in 1977, manufactures radiation-based, computer-automated instruments that support the measurement and inspection needs of research and manufacturing organizations. The firm offers a comprehensive spectrum of capabilities ranging from concept formulation, computer simulation, experimental evaluation, engineering design, software development, and system integration which lead to prototype demonstration, product manufacturing and post-

warranty services. The current product line includes the Model 1500 family of industrial computed tomography systems and the Model 4100 Automatic Semiconductor Irradiation System. R&D areas include tomographic and radiographic imaging technology, radiation sensors, x-ray optics and analytical methods, and semiconductor material and device characterization.

Contact: Michael Boyle
408-733-7780

Product(s) Described:

E.01: ARACOR VLSI Qualification Test System

K.01: High-Energy, Dual-Energy Computed Tomography Detector Package

K.02: QUEST Integrated Load-Frame and Computed-Tomography System

L.01: Miniature Materials Analysis X-Ray Laboratory

Advanced System Technologies, Inc.

12200 East Briarwood Avenue, Suite 260
Englewood, CO 80112

Advanced System Technologies provides system engineering services and products for the performance and reliability analysis of real-time computer systems.

Contact: David Flanagan
303-790-4242

Product(s) Described:

A.01: QASEORT

Aerodyne Research, Inc.

Center for Chemical & Environmental Physics
45 Manning Road
Billerica, MA 01821-3976

Aerodyne Research is engaged in basic research, computer modeling, field measurements and instrument development in the areas of electronic materials, combustion, and atmospheric and environmental science.

Contact: Kurt D. Annen
508-663-9500

Product(s) Described:

J.01: DIFKIN, A Coupled-Mass Transport and Chemical Kinetics Code for CVD Modeling

N.01: Rayleigh Scattering Diagnostic for Density and Temperature Measurements

S.01: Atmospheric Trace Gas Fluxmeter

Aerometrics, Inc.

550 Del Rey Avenue, Unit A
Sunnyvale, CA 94086

Aerometrics offers a wide range of particle analysis equipment including laser Doppler velocimeter and phase Doppler particle analyzer one-, two- and three-dimensional, standard or fiber-optic systems. Since the initial development of the Phase Doppler Particle Analyzer (PDPA), Aerometrics has extended the capabilities of the PDPA by offering various system tools and accessories. Aerometrics will customize any system to fit the user's unique testing environment. The firm also provides services such as in-house and on-site testing as well as research and development.

Contact: Tracy Fowler
408-738-6688

Product(s) Described:

N.02: The Phase Doppler Particle Analyzer

ANCO Engineers, Inc.

9937 Jefferson Boulevard
Culver City, CA 90232-3591

ANCO's consulting engineers specialize in seismic testing and analysis, energy management, and vibration monitoring.

Contact: Paul Ebanes
213-204-5050

Product(s) Described:

K.03: Instrumented Torque Wrench (INTOWS)

AOTF Technology, Inc.

See Addendum, page 56, column 2

APA Optics, Inc.

2950 N.E. 84th Lane
Minneapolis, MN 55434

APA Optics is a high technology company engaged in precision optics design and fabrication, computer-generated holographic products, optoelectronic materials (III-V), opto-electronic device design and processing.

Contact: Herb Linquist
612-784-4995

Product(s) Described:

H.01: Solid State Laser Scanner

Astro International Corporation

Aerospace Division
100 Park Avenue
League City, TX 77573

Astro International Corporation produces analytical instrumentation and safety monitoring equipment for critical environments.

Contact: Robert Ashcraft
713-332-2484

Product(s) Described:

T.01: Process-Control Water Quality Monitor

Bauer Associates, Inc.

177 Worcester Road, #101
Wellesley, MA 02181

Bauer Associates performs consulting and R&D for electro-optical systems and produces an optical profilometer for ultra-accurate surface contour measurements of aspheric optics.

Contact: Paul Glenn
617-235-8775

Product(s) Described:

H.02: Model 100 Profilometer

Bend Research, Inc.

64550 Research Road
Bend, OR 97701-8599

Bend Research engages in contract research and development.

Contact: Robert F. Frisbee
503-382-4100

Product(s) Described:

T.02: Prototype Membrane-Based Wash-Water Recovery Unit

Bio-Imaging Research, Inc.

425 Barclay Boulevard
Lincolnshire, IL 60069

Bio-Imaging Research is a developer and manufacturer of radiographic imaging systems for industrial applications of non-destructive testing. Products include x-ray computed tomography and digital radiography inspection systems, high-efficiency x-ray detectors, and image processing hardware and software. The company also provides design services for a variety of medical, electronic, and industrial product development projects.

Contact: Barbara R. Krohn
708-634-6425

Product(s) Described:

K.04: Dual-Beam Lens for Micro-NDE

Biochem Technology, Inc.

100 Ross Road, P. O. Box 1366
King of Prussia, PA 19406

BioChem Technology develops technology for enhancing the productivity of bioreactors and biological processing. Its primary products are the FluroMeasure^(R) System and the BioGuide^(TM) System for monitoring and control of fermentation and waste treatment plants.

Contact: William B. Armiger
215-768-9360

Product(s) Described:

U.01: FlurO₂

Biospherical Instruments, Inc.

4901 Morena Boulevard, Suite 1003
San Diego, CA 92117

Biospherical Instruments' specializes in the research, design, and manufacturing of innovative optical instrumentation for the oceanographic and atmospheric sciences community and for general environmental monitoring.

Contact: John H. Morrow
619-270-1315

Product(s) Described:

R.01: PNF-300 Profiling Natural Fluorometer

R.02: MER-2020 Oceanographic Instrument

BoMed Medical Manufacturing, Ltd.

15 Musick
Irvine, CA 92718

BoMed has pioneered bio-impedance technology for noninvasive hemodynamic and cardiodynamic assessment, monitoring, and therapeutic management for use in hospitals and physicians' offices.

Contact: Hevka Sramek
714-770-5322

Product(s) Described:

U.02: CDDP Non-Invasive Hemodynamic Patient Management System

U.03: PaceMate

Bonneville Scientific, Ltd.

918 East 900 South
Salt Lake City, UT 84105

Bonneville Scientific is a Utah corporation founded in 1981 to research, develop, and commercialize ultrasonically-based force and pressure-sensing products.

Contact: Josephine M. Grahm
801-359-0402

Product(s) Described:

C.02: Robotic Tactile Sensor System

Cambridge Research & Instrumentation, Inc.

21 Erie Street
Cambridge, MA 02139

Cambridge Research & Instrumentation is engaged in commercial sale of laser intensity stabilizers, absolute cryogenic radiometers, and liquid-crystal tunable optical filters and performs research in the field of solar astrophysics.

Contact: Peter V. Foukal
617-491-2627

Product(s) Described:

F.01: Auto-Cal Detector Calibration System

Charles River Analytics, Inc.

55 Wheeler Street
Cambridge, MA 02138

Charles River Analytics engages in contract aerospace research and development and CASE tools.

Contact: Alper K Caglayan
617-491-3474

Product(s) Described:

B.02: SDL CASE Tool

Chronos Research Labs, Inc.

4186 Sorrento Valley Boulevard #H
San Diego, CA 92121

Chronos Research Labs is an energy research firm.

Contact: Randall B. Olson
619-455-8200

Product(s) Described:

Q.01: Pyroelectric Converter

Coleman Research Corporation

Digital Signal Division
6551 Loisdale Court, Suite 800
Springfield, VA 22150

Coleman Research Corporation is engaged in engineering research and development of coherent laser vision and metrology sensors and devices. Products include: contour mappers for precision volume metrology; vision systems for telerobotics and NDE; Hydras, a multiplexed sensor set, with up to 100 similar or dissimilar coherent optical sensors multiplexed off a single electronics/optics head and transmitted via fiber-optics; proximity fuses for weapon fusing; three-dimensional artificial vision system.

Contact: James Genova
703-719-9200

Product(s) Described:

H.03: Eagle 3004 Vision System

Complere, Inc.

P. O. Box 1697
Palo Alto, CA 94302

Complere conducts basic and applied research in fluid mechanics and energy systems. This work is primarily in the area of advanced flow-field diagnostics and includes the design and manufacture of two- and three-component laser velocimeters, hot wire turbulence and dynamic pressure measurement systems, and controllers, interfaces and software for data acquisition and analysis. Current projects range from water-tunnel, vortex-flow diagnostics to hypersonic flow experiments designed to improve the turbulence modeling data base for NASP.

Contact: F. Kevin Owen
415-321-5630

Product(s) Described:

M.01: An Optical Angle-of-Attack Sensor

Computational Mechanics Company, Inc.

7701 North Lamar Street, Suite 200
Austin, TX 78752-1022

The Computational Mechanics Company develops state-of-the-art computer software for modeling computational solid mechanics and computational fluid dynamic applications. Special emphasis is directed toward the use of "smart" algorithms to optimize the numerical process and produce the best possible computational results for the least computational effort.

Contact: Jon M. Bass
512-467-0618

Product(s) Described:

N.03: PHLOW

Conax Buffalo Corporation

Aerospace Industrial Division
2300 Walden Avenue
Buffalo, NY 14225

Conax Buffalo Corporation, Aerospace Industrial Division, designs and manufactures fiber-optic and conventional sensors for the industrial and aerospace markets.

Contact: Samuel Algera
716-684-4500

Product(s) Described:

N.04: Optical-Fiber Temperature Sensor

Continuum Dynamics, Inc.

P. O. Box 3073
Princeton, NJ 08543

Continuum Dynamics carries out contract research, software development, and consulting engineering tasks for both U.S. government agencies and commercial customers. CDI has a wide range of projects currently underway, including work in rotorcraft and aircraft aerodynamics, computational aeroelasticity, aerosol modeling, road vehicle aerodynamics, and acoustics.

Contact: Todd R. Quackenbush
609-734-9282

Product(s) Described:
M.02: EHPIC Mod 2.0
M.03: RotorCRAFT

Creare, Inc.
Etna Road, P. O. Box 71
Hanover, NH 03755

Creare is an advanced engineering firm established in 1961. Creare's services span applied research, engineering design, new product and process development, computational fluid dynamics, mechanistic analysis, large-scale testing, small model studies, software development, and problem-solving consulting.

Contact: Carolyn Keats
603-643-3800

Product(s) Described:
O.01: High-Heat-Flux, Condensing Heat Exchanger
O.02: High-Heat-Flux, Single-Phase Exchanger
P.01: Helium Transfer Pump

Cybernet Systems Corporation
1919 Green Road, Suite B-101
Ann Arbor, MI 48105

Cybernet Systems Corporation focuses on high technology research, development, and derivative specialty products to make people safer and more productive. Through evolutionary application of advanced technology in human-computer interfaces and computer-aided instruction and training, robotics and automation, and artificial intelligence, Cybernet Systems integrates people-centered systems for industry, the military, and space. Cybernet Systems is qualified to carry out all types of military and civilian R&D and commercialization project categories.

Contact: Heidi N. Jacobus
313-668-2567

Product(s) Described:
C.03: Cybernet Force-Reflecting Handcontroller
C.04: CyberImage
C.05: Holotrack

Daedalus Enterprises, Inc.
P. O. Box 1869
Ann Arbor, MI 48106-1869

Daedalus Enterprises develops and manufactures airborne multispectral imaging systems for remote sensing.

Contact: Keith A. More
313-769-5649

Product(s) Described:
R.03: AOCI
S.02: Wildfire

EIC Laboratories, Inc.
111 Downey Street
Norwood, MA 02062

EIC Laboratories' business includes battery development and limited battery production, and electrochromic display development, with limited production of displays.

Contact: Dennis N. Crouse
617-769-9450

Product(s) Described:
H.04: Alpha-Numeric Electrochromic Displays
Q.02: ReLi® Rechargeable Lithium Cells and Batteries

Eidetics International, Inc.
3415 Lomita Boulevard
Torrance, CA 90505

Eidetics is a fighter-aircraft design technology corporation focused on development of new aeronautical technologies in aerodynamics, propulsion, flight controls, avionics, structures, simulation and operational requirements. In addition, Eidetics manufactures and installs flow-visualization water tunnels for aeronautical research and supporting preliminary aircraft design tasks.

Contact: Gerald Malcolm
213-326-8228

Product(s) Described:
M.04: Force and Moment Balance for Water Tunnels
M.05: Forebody Vortex Control

Energy Science Laboratories, Inc.
Thermal Composites Division
6888 Nancy Ridge Drive
San Diego, CA 92121

Energy Science Laboratories engages in research and development in energy and aerospace materials, contracting with NSF, USAF, SDIO, NASA,

Army, and aerospace firms. Its facilities are equipped for vacuum (evaporation, sputtering, amass spectrometry) CVD/CVI, materials preparation, microelectronic fabrication, chemistry, cryogenics, optics, thermal analysis, machining, and computing.

Contact: Timothy R. Knowles
619-552-2034

Product(s) Described:

Q.03: Composite-Matrix Regenerators for Stirling-Cycle Engines

Femtometrics

1001 West 17th Street, Suite R
Costa Mesa, CA 92627

Femtometrics conducts research, development, and fabrication of analytical instrumentation to detect and quantify trace quantities of chemical vapors and particulates (aerosols).

Contact: William D. Bowers
714-722-6239

Product(s) Described:

S.03: 200 MHz Surface Acoustic Wave Aerosol Particle and Chemical Vapor Sensor

S.04: A Non-Optical, Real-Time Particle Fallout Monitor

Fluent Inc.

P. O. Box A-219
Hanover, NH 03755

Fluent Inc. conducts development, marketing, and support of CFD software for industry and research facilities world-wide.

Contact: Steve Rozov
603-643-2600

Product(s) Described:

N.05: NEKTON® Fluid-Flow Numerical Simulator

Foster-Miller, Inc.

350 Second Avenue
Waltham, MA 02154-1196

Foster-Miller is a 300-employee company specializing in new product development. Founded by a group from the Massachusetts Institute of Technology in 1956, it draws on the vast educational and technological resources of the Northeast to provide

vide diverse expertise in thermal and energy technologies; robotics; special mechanisms and machinery; nuclear power plant inspection and maintenance equipment and services; polymer chemistry and processing; composite design and processing; structural/civil inspection and analysis tools and technologies; and fiber-optics and non-linear optics technologies.

Contact: Jeffrey Goldman
617-890-3200

Product(s) Described:

C.06: Serpentine Truss Robot

I.01: Biaxially Oriented Liquid Crystal Polymer Film

I.02: Foster-Miller Polymer Reaction Monitor

I.03: Polyamide/Liquid-Crystal-Polymer Blend

O.03: Nonazeotropic Heat Pump for Water Heating

General Pneumatics Corporation

Western Research Center
7662 East Gray Road, Suite 107
Scottsdale, AZ 85260-6910

The General Pneumatics Western Research Center was established in 1983 in Scottsdale, Arizona, to develop advanced cryo-refrigerators, Stirling systems, and innovative approaches to energy conversion and thermal management for commercial, medical, and aerospace applications.

Contact: Steven G. Zylstra
602-998-1856

Product(s) Described:

P.02: Joule-Thomson Cryostat

Geo Centers, Inc.

Sensor Systems Group
7 Wells Avenue
Newton Centre, MA 02159

Geo-Centers is a small business based in Newton, Massachusetts with offices in Washington, DC; Albuquerque, New Mexico; and Dover, New Jersey. Incorporated in 1973, Geo-Centers has been successfully developing fiber-optic sensors, geophysical instrumentation, remote diagnostic measurement systems, electromagnetic-based sensors and antennas, and other advanced instrumentation systems. Geo-Centers' primary business is in the government services area. However, significant in-house research and development is maintained by the corporation. Geo-Centers formed the Sensor Systems Group in 1987, to develop

fiber- and optical-based measurement systems for commercial sale.

Contact: Bruce N. Nelson
617-964-7070

Product(s) Described:

H.05: Multimode Optical Switch and Control Unit

I.04: Distributed Fiber-Optic Composite-Material Cure Monitoring and Control System

U.04: Fiber-Optic pH Optrode and Electronics Interface

Geoscience Limited

410 South Cedros Avenue
Solana Beach, CA 92075

Geoscience Limited is a research and development firm that works in the areas of heat transfer, fluid mechanics, materials science and technology, and biophysics. In the biophysics area, one of the company's major activities relates to the measurement of metabolic heat releases (and their three components) for animals and humans at the Earth's surface and in space.

Contact: Heinz F. Poppendiek
619-755-9396

Product(s) Described:

U.05: Calorimeter and Waste Management System

I-Kinetics, Inc.

19 Bishop Allen Drive
Cambridge, MA 02139-3512

I-Kinetics, Inc., specializes in developing and marketing software solutions for very large distributed systems. I-Kinetics' MetaData, I-Gates, and I-Brouters represent the cornerstone technology of the distributed system product family. These products are targeted at frustrated customers who want to integrate their in-place systems and applications rather than port them. Each product is aimed at reducing the cost of integrating disparate applications into coherent distributed information systems in situations where previously there were no workable solutions. Customers are using these products to develop distributed systems in such areas as financial management, integrated CAD/CAM, network system management and launch operations.

Contact: Bruce H. Cottman
617-661-8181

Product(s) Described:

B.03: MetaData

Infrared Laboratories, Inc.

1808 East 17th Street
Tucson, AZ 85719

Infrared Laboratories was established in 1967 to serve the research community throughout the United States and many foreign countries by supplying infrared and cryogenic equipment. The company's product list includes bolometers, bolometer arrays, discrete photoconductors, large-area infrared camera systems, a wide variety of standard and customized liquid nitrogen and liquid helium research dewars, ³He cryostats, hybrid passive and mechanical coolers, custom optics, filters, and amplifiers.

Contact: Eric Low
602-622-7074

Product(s) Described:

F.02: Cryogenic TIA Input Stage

F.03: JF-4 Integrating Cryogenic Amplifier

Integrated Systems, Inc.

3260 Jay Street
Santa Clara, CA 95054-3309

Integrated Systems designs, develops, markets, and supports an integrated family of CAE/CASE software and hardware products that automate and accelerate the development of real-time software and systems. These products are used in the design, simulation, coding, implementation, and testing phases of development for real-time control applications in a variety of industries, including aerospace, automotive, industrial automation, and computer peripherals.

Contact: Robert Kosut
408-980-1500

Product(s) Described:

C.07: RT/Expert

Interferometrics, Inc.

8150 Leesburg Pike, Suite 1400
Vienna, VA 22182-2799

Interferometrics is devoted entirely to research, scientific investigation, technical analysis, and the design and construction of hardware associated

with complex systems for NASA, the Department of Defense, the international radio astronomy community, and commercial space telecommunications companies.

Contact: E. James Wadlak
703-790-8500

Product(s) Described:

D.01: Interferometric Satellite Tracking System

International Technical Associates

Robotics Division
2281 Calle De Luna
Santa Clara, CA 95054

The Robotics Division at International Technical Associates (INTA) specializes in custom applications of laser robotic workcells. As a systems integrator, INTA will combine laser, robot, vision, and control to provide a fully functional and optimized workcell. Some of the applications previously addressed include: cutting, welding, etching, and coatings removal.

Contact: Phil Barone
408-748-9955

Product(s) Described:

J.02: Real-Time, Adaptive-Vision Welding Guidance System

ISX Corporation

4353 Park Terrace Drive
Westlake Village, CA 91361

ISX Corporation builds deliverable, intelligent systems that leverage advanced computing technology to solve real-world operational problems.

Contact: Bruce Bullock
818-706-2020

Product(s) Described:

A.02: Intelligent Computational Resource Management System

C.08: Ground Vehicle Manager's Associate

Ithaco, Inc.

Space Systems Division
735 West Clinton Street
Ithaca, NY 14851-6437

The Space Systems Division of Ithaco designs and manufactures systems and components for satellite attitude control and determination. Products

include earth sensors, reaction/momentum wheels, magnetic TORQRODS and magnetometers.

Contact: Vaughn H. Selby
607-272-7640

Product(s) Described:

V.01: T-Reaction Wheel

V.02: T-SCANWHEEL

Laser Power Corporation

Laser Power Research Division
12777 High Bluff Drive
San Diego, CA 92130

Laser Power Corporation produces optics for high-power lasers and FLIR systems. The corporation manufactures standard and special components including lenses, mirrors, beam expanders, polarizers, prisms, windows, beam splitters, and phase shifters. The research division specializes in the development of laser countermeasures and photon noise-limited imaging systems.

Contact: Graham Flint, Elena Morris
619-755-0700

Product(s) Described:

D.02: Digital Image Profiler

Lightwave Electronics Corporation

1161 San Antonio Road
Mountain View, CA 94043

Lightwave Electronics Corporation designs, manufactures, and sells laser diode-pumped solid-state laser products on an end-user and original equipment manufacturer basis into a variety of markets including those for semiconductor manufacturing equipment and research and developments. Secondly, the company carries out U.S. government contract research.

Contact: Tim Gray
415-962-0755

Product(s) Described:

H.06: Series 120 Diode-Pumped Solid-State Ring Laser

H.07: Series 122 Diode-Pumped Solid-State Non-Planar Ring Laser

Macrodyne, Inc.

4 Chelsea Place, P. O. Box 376
Clifton Park, NY 12065

Macrodyne designs and manufactures a product line of laser Doppler velocimeter hardware used by the fluids researcher to nonintrusively measure the velocity and frequency of micron-sized particles flowing across a laser-beam fringe pattern in a measuring volume of a complex flow field.

Contact: R. Jay Murphy
518-383-3800

Product(s) Described:

B.04: FDP 3100 Frequency Domain Processor

Mainstream Engineering Corporation

Thermal Systems Division
200 Yellow Place
Rockledge, FL 32955

Mainstream Engineering Corporation performs research and development on innovative thermal, fluid, and chemical systems for thermal management applications. Mainstream is extensively involved in research and development of thermal management systems and components, ranging from hardware development to working fluid research to computer simulation of thermal management systems. Applications range from personal cooling to spacecraft thermal management.

Contact: Lawrence R. Grzyll
407-631-3550

Product(s) Described:

O.04: Nontoxic, Two-Phase, Heat Transport Fluid

O.05: SCAPE-Suit Heater

Q.04: Chemical/Mechanical Heat Pump

Mayflower Communications Company

80 Main Street
Reading, MA 01867

Mayflower Communications Company is an advanced navigation and communications systems research and development firm. It develops hardware systems, including advanced signal processing boards, GPS-based systems, 80386/486 boards for avionics. Mayflower has developed Ada software systems ranging from RS232 modules to complete, real-time navigation systems. Mayflower also provides services to the FAA for its communications and ATC projects.

Contact: Triveni Upadhyay, Steve Cotterill
617-942-2666

Product(s) Described:

D.03: Real-Time Integrated GPS/INS Navigation and Attitude Determination Software

McMahan Electro-Optics, Inc.

Building 4401, Suite 219
79 T.W. Alexander Drive
Research Triangle Park, NC 27709

McMahan Electro-Optics conducts research and development in non-conventional imaging, sensor fusion and multi-spectral imaging, optical neural networks, fuzzy logic, laser-based systems for NDT/E of composite materials and assemblies.

Contact: Robert McMahan, Sr.
919-549-7575

Product(s) Described:

K.05: Dynamic Laser Speckle Profilometer (DyLASP)

Metadyne, Inc.

P. O. Box 242
Elmira, NY 14902

Metadyne develops and manufactures refractory metal alloys of molybdenum and tungsten for elevated temperature applications. The company also manufactures powder-metallurgy components of tungsten, tungsten-carbide, and molybdenum alloys.

Contact: Raman L. Daga
607-732-1300

Product(s) Described:

I.05: Tungsten and Molybdenum Alloys

Micro-G Research, Inc.

3401 Market Street, Suite 345
Philadelphia, PA 19014-3323

Micro-G Research designs and develops space flight or flight-related equipment for investigators interested in conducting research in microgravity. It provides technical assistance to other experimenters developing testing programs for flight hardware.

Contact: David K. Chapman
215-387-9339

Product(s) Described:

U.06: Variable-Speed Mid-Deck Centrifuge

Microwave Monolithics, Inc.

465 East Easy Street, Unit F
Simi Valley, CA 93065

Microwave Monolithics Incorporated develops and supplies GaAs monolithic microwave integrated circuits (MMICs) for a variety of systems applications, and components and subsystems based on these MMICs. Activities include custom MMIC component services, MMIC prototype services, and research and development. MMLinc. has the in-house capability to design, fabricate, characterize, and optimize custom MMIC-based components, including non-standard processing not available via "foundry" services. The company also works in close consultation with OEMs to develop customer-specific prototypes for maximum systems leverage. MMLinc. is also under contract with U.S. government agencies on a number of advanced components and technology development programs.

Contact: Daniel R. Ch'en
805-584-6642

Product(s) Described:

G.01: Custom, Fully Monolithic GaAs Switch Matrix Subsystems

Mid-South Engineering, Inc.

2131 Belcourt Avenue
Nashville, TN 37212

Mid-South Engineering is a engineering consulting and research firm with specialization in welding and control system design.

Contact: Kristinn Andersen, Joel Barnett,
James Springfield
615-383-8877

Product(s) Described:

J.03: Model 1000 Welding Controller

Morton International

Advanced Materials Division
185 New Boston Street
Woburn, MA 01801-6278

Morton International is a manufacturer of bulk infrared optical transmission materials, including polycrystalline zinc-sulfide and zinc-selenide for fabrication of laser components and thermal imaging and detection systems; high-purity organometallics including trimethyl gallium for making advanced gallium-arsenide semiconductors; and monolithic CVD-substrate reflective optics.

Contact: William R. Haigls
617-933-9243

Product(s) Described:

I.06: CVD Silicon Carbide™

Netrologic, Inc.

5080 Shoreham Place, Suite 201
San Diego, CA 92122

Netrologic performs neural networks applications, research, and development with special emphasis on diagnostics and robotics.

Contact: Daniel R. Greenwood
619-587-0970

Product(s) Described:

B.05: Neural Networks for Fault Monitoring

Odetics, Inc.

1515 South Manchester Avenue
Anahelm, CA 92802-2907

Odetics develops and markets automation products that store and control information. The company's products include data records for space applications, remote surveillance and security systems, tape-library storage and retrieval systems, and precision time-measurement instruments.

Contact: George B. Westrom
714-774-5000

Product(s) Described:

C.09: Motion Planning Algorithms for Dexterous Manipulator

C.10: Odetics Dexterous Manipulator

D.04: Adaptive Imager

Omitron, Inc.

6305 Ivy Lane, Suite 500
Greenbelt, MD 20770

Omitron specializes in aerospace systems engineering, software engineering, spacecraft and sensor operations, and specialized hardware development. Advanced products in preparation include an expert system for applications such as spacecraft anomaly investigation and diagnostics and ground-support equipment for instrument conditioning while at the launch pad.

Contact: Frederick J. Hawkins
301-474-1700

Product(s) Described:

A.03 Spacecraft Supercomputer
B.06: Sentinel

Physical Research, Inc.

Instrumentation Group
25500 Hawthorne Boulevard, #2300
Torrance, CA 90505-6828

Physical Research scientists and technicians perform laboratory and field experiments in fluid mechanics, holographic interferometry, laser Doppler anemometry, non-destructive testing, fiber optics and electro-optics.

Contact: Bill Shi, Sandy Simms
213-378-0056

Product(s) Described:

M.06: Burst Frequency Processor

Physical Sciences Inc.

20 New England Business Center
Andover, MA 01810

Physical Sciences basic business activity is in contract research and development in a wide diversity of areas. Recent extensions of corporate activities include development of commercial products and provision of testing surfaces.

Contact: Linda Cribbis
508-689-0003

Product(s) Described:

K.06: Fast Atom Sample Tester (FAST™)

PSI Technology Company

Physical Sciences Inc.
20 New England Business Center
Andover, MA 01810

The Electro-Optic Instrumentation Group of PSI Technology performs research, development, and application of specialized computer-coupled electro-optic instrumentation to serve defense, aerospace, industrial, and medical markets.

Contact: Michael B. Frish
508-689-0003

Product(s) Described:

L.02: Multi-Color Imaging Pyrometer
L.03: Optical Temperature Monitor

QCI, Inc.

P. O. Box 1067
Oak Ridge, TN 37831

QCI develops, manufactures, and markets quality control instruments to the plating industry and to inspection departments. It is an active exporter, with products in 30 countries. QCI is a winner of the R&D 100 award.

Contact: Roger W. Derby
615-483-6498

Product(s) Described:

K.07: Thermoelectric Microprobe

Radiation Monitoring Devices, Inc.

44 Hunt Street
Watertown, MA 02172

Radiation Monitoring Devices is a manufacturer of semiconductor devices and instruments based on nuclear radiation techniques.

Contact: Michael R. Squillante
617-926-1167

Product(s) Described:

K.08: Z Sensor

Ribbon Technology Corporation

825 Taylor Station Road
Blacklick, OH 43004

Ribbon Technology (Ribtec) is the world's largest manufacturer of stainless steel fibers used for reinforcing refractory concretes. Ribtec also provides contract research and development services for government and industry. Ribtec operates plasma arc furnaces for melting and casting reactive and refractory alloys to produce strip, ribbons, fibers and filaments through rapid solidification processing.

Contact: Lloyd E. Hackman
614-864-5444

Product(s) Described:

I.07: Titanium Fibers, Filaments, Strips, and Foils

Ross-Hime Designs, Inc.

1313 5th Street, SE, #221
Minneapolis, MN 55414

Ross-Hime Designs engages in R&D of robotic mechanisms: wrists, hands, arms, legs, etc.

Contact: Mark Elling Roshelm
612-379-3808

Product(s) Described:
C.11: Omni-Wrist

SatCon Technology Corporation

12 Emily Street
Cambridge, MA 0139-4507

SatCon is a research and development company concentrating on electro-mechanical control systems. The technology areas necessary for these particular systems are actuators, controllers, sensors, power electronics, and system integration. SatCon has recognized authorities in each of these areas.

Contact: Rhonda C. Raffl
617-661-0540

Product(s) Described:

- A.04: Magnetic Bearings for High-Performance Optical-Disk Buffer**
- V.03: Active Magnetic Micro-Gravity Isolator for Space Station**
- V.04: Superconducting Large-Angle Magnetic Suspension**
- V.05: An Integrated Micro-Gyroscope**

Schmidt Instruments, Inc.

2476 Bolsover, Suite 290
Houston, TX 77005

Schmidt Instruments focuses on three interconnected businesses. The first is instrumentation—expertise in the development, manufacture, and marketing of advanced control, data acquisition, and physical instrumentation components and systems, with specialization in time-of-flight mass spectrometers. The second is diamond growth—research efforts include heteroepitaxial diamond growth, N-Type doping of diamond, conversion of CFCs into diamond, low-temperature diamond growth, and DLC growth. Third is remote sensing—UV laser-induced fluorescence with lidar.

Contact: Howard K. Schmidt, Lloyd Bridges,
Michael Clark
713-529-9040

Product(s) Described:

- L.04: Space-Rated, Rugged, Compact Time-of-Flight Mass Spectrometer**

Schwartz Electro-Optics, Inc.

Solid State Laser Division
3404 North Orange Blossom Trail
Orlando, FL 32804

The Solid State Laser Division of Schwartz Electro-Optics designs and manufactures a line of solid state CW and pulsed lasers for a variety of scientific, medical, industrial, and OEM applications.

Contact: Sidney Wright
407-298-1802

Product(s) Described:

- H.08: Cobra 2000 Laser**

Scientific Materials Corporation

310 Icepond Road, P. O. Box 786
Bozeman, MT 59715

Scientific Materials Corporation's primary products and activities are: ultra quality Nd:YAG and CTH:YAG laser rods; new crystal hosts; crystal properties study sample. It achieves the above at a reasonable cost. SM works with clients to jointly produce superior laser products for the ever-growing demands of opto-electronics.

Contact: Edward J. Niemczyk
406-585-3772

Product(s) Described:

- H.09: Yttrium-Aluminum-Garnet Laser Rods**

Scientific Research Associates, Inc.

P. O. Box 1058
Glastonbury, CT 06033

Scientific Research Associates provides scientific software and analysis for fluid dynamics, materials processing, solid-stated devices, and electro-optics. It has experimental facilities for fluid dynamics and electro-optics research. They develop sensors for commercial and military applications and do design and analysis consulting for all the aforementioned areas.

Contact: Stephen Shamroth
203-659-0333

Product(s) Described:

- N.06: Particle Tracking Computer Software**

SECA, Inc.

3311 Bob Wallace Avenue, Suite 203
Huntsville, AL 35805

SECA specializes in computational fluid dynamics code development and application to the solution of complex fluid mechanics problems.

Contact: Richard C. Farmer
205-534-2008

Product(s) Described:

N.07: The FDNS CFD Code

Shason Microwave Corporation

1730 NASA Road 1, Suite 101
Houston, TX 77058

Shason Microwave Corporation is an engineering, technology and manufacturing company supporting the commercial telecommunication market and federal and civil agencies. The market for these services and products is high-technology electronics systems such as radar systems, solid-state (phased-array) antenna systems, satellite communication systems, and digital communication systems. Shason Microwave is involved in the custom application of microwave monolithic integrated circuits (MMICs) and the development of multi-function miniature components for communication and radar systems.

Contact: Roland Shaw
713-333-1950

Product(s) Described:

F.04: Automated Reliability Test Set for Electronic Modules

G.02: Solid-State Active Ku-Band Antenna

SKW Corporation

1040 Calle Cordillera, Suite 105
San Clemente, CA 92672

SKW provides support to various government agencies in program management, system analysis and design, and advanced mathematical analysis. A particular strength is in infrared satellite development and related technologies.

Contact: Scott Bartel
714-361-5660

Product(s) Described:

S.05: Space Particulate Imaging Measurement Sensor

Software Productivity Solutions, Inc.

122 North Fourth Avenue
Indianapolis, FL 32903

Software Productivity Solutions is a high-tech software company that specializes in advanced software products to improve software development productivity and increase software quality.

Contact: Edward R. Comer
407-984-3370

Product(s) Described:

B.07: InQuisiX

Solar Kinetics, Inc.

10635 King William Drive
Dallas, TX 75220

Solar Kinetics is a leading developer and manufacturer of various solar technologies. These include thermal, concentrating photovoltaic, and photochemical systems. The company has fabricated large, lightweight, stretched-membrane parabolic dishes ranging in diameter from 3 to 7 M. It has designed and installed turn-key parabolic trough fields for space and process heating and has developed concentrators for use in earth orbit. The company has also developed prototypes of 300-sun photovoltaic concentrators and plans to produce them.

Contact: J.A. Hutchison
214-556-2376

Product(s) Described:

Q.05: Ultra-Lightweight, All-Metal Mirror Facet for a Solar-Dynamic Power System

Space Instruments, Inc.

4403 Manchester Avenue, Suite 203
Encinitas, CA 92024

Space Instruments is engaged in electro-optical instrument design.

Contact: James W. Hoffman
619-944-7001

Product(s) Described:

S.06: Cloud Top Radiometer

Spectral Sciences, Inc.

99 South Bedford Street, #7
Burlington, MA 01803-5169

Spectral Sciences performs optical research and development.

Contact: Steven Adler-Golden
617-273-4770

Product(s) Described:

S.07: Raman Gas-Monitoring System

Spire Corporation

Surface Engineering Division
One Patriots Park
Bedford, MA 01703

The Surface Engineering Division of Spire Corporation performs surface modification services and builds equipment for ion-assisted coatings and ion implantation.

Contact: Bruce Haywood
617-275-6000

Product(s) Described:

J.04: Ion-Beam-Assisted Deposition

J.05: IonGuard® Surface Treatment

Spire Corporation

Electronic Materials Division
One Patriots Park
Bedford, MA 01703

Spire's Electronic Materials Division is the leading merchant supplier of MOCVD-grown GaAs, GaAlAs, InP, and InGaAs epitaxial wafers for use in electronic, opto-electronic and microwave devices.

Contact: Kurt Linden
617-275-6000

Product(s) Described:

**E.02: Indium-Phosphide Epitaxial Wafers
and Solar Cells**

E.03: III-V Compound Epi-Wafers

Springborn Laboratories, Inc.

Materials Science Division
One Springborn Center
Enfield, CT 06082

The Materials Science Division of Springborn Laboratories performs contract materials testing, research, development and engineering laboratory

services, including product and process development, prototype manufacturing, plastics conversion via injection, compression and transfer molding and extrusion. It is also involved in the R&D of non-metallic materials including plastics, adhesives, coatings, and sealants, plus materials analysis and characterization through analytical and physical property determinations.

Contact: James P. Galica
203-749-8371

Product(s) Described:

I.08: Clean-Room Floor Tile Covering

Stirling Technology Company

2952 George Washington Way
Richland, WA 99352

Stirling Technology Company conducts research and development of technology related to long-life, maintenance-free Stirling cycle machines used in space and terrestrial power-producing and cryogenic cooling systems.

Contact: Maurice A. White
509-375-4000

Product(s) Described:

P.03: Domestic Stirling Cycle Refrigerator

P.04: Long Life Cryocoolers

Strainoptic Technologies, Inc.

108 West Montgomery Avenue
North Wales, PA 19454

Strainoptic manufactures and markets optical instruments for measuring strain, stress, and birefringence. The line includes optical polariscopes and polarimeters, polarizers and retarders, compensators and accessories for visual analysis, and PC-based Digital Image Analysis system. The spectral contents based birefringence measuring devices were recently incorporated, expanding the line.

Contact: Alex S. Redner
215-661-0100

Product(s) Described:

J.06: EO-1500 Spectral Contents Analyzer

Symbiotics, Inc.

875 Main Street
Cambridge, MA 02139

Symbiotics designs and sells software products for distributed computing. MetaCourier, the com-

pany's primary product, creates a transparent "open systems" network. MetaCourier's advanced object-oriented technology shields programmers and end-users from low-level network protocols and operating system and processor dependencies. It is the first tool to provide high-level "plug and go" connectivity between arbitrary applications across heterogeneous computer networks.

Contact: Richard M. Adler
617-876-3633

Product(s) Described:
B.08: SOCIAL

Systems Technology, Inc.
13766 South Hawthorne Boulevard
Hawthorne, CA 90250-7083

Systems Technology performs contract research and consulting in vehicle dynamics, control and human factors, and development of specialized, related software.

Contact: Jun Talra
213-679-2281

Product(s) Described:
A.05: Program CC, Version 4

Telenexus, Inc.
1410 Summit Avenue, Suite 1
Plano, TX 75074

Telenexus provides products and services in digital wireless communications. Products include wireless headset systems and wireless modems. Products can be modified for remote monitoring and control applications.

Contact: Chuck Lau
214-423-0667

Product(s) Described:
F.05: Wireless Headset Network

TeleRobotics International Inc.
7325 Oak Ridge Highway
Knoxville, TN 37921

TeleRobotics International is a small, high-tech, associate-held company involved in a wide range of diverse disciplines. TRI is currently developing products for robotics, imaging, industrial control, multimedia, and interactive training applications. Products include CourseBuilder, InteractV, TeleMate, and Omniview.

Contact: Steve Zimmermann
615-690-5600

Product(s) Described:
H.10: Omniview

The Navtrol Company, Inc.
9204 Markville Drive
Dallas, TX 75243

The Navtrol Company designs and manufactures digital servo control, tracking, and instrumentation systems including gyro-stabilized systems.

Contact: Richard J. Brown
214-234-3319

Product(s) Described:
C.12: Dual-Axis, Digital Servo Controller

Thermacore, Inc.
780 Eden Road
Lancaster, PA 17601

Thermacore, a unit of DTX Corporation, is a heat-transfer company that specializes in the design, development, and manufacturing of heat pipes and thermal transfer devices for commercial and military customers.

Contact: Donald M. Ernst
717-569-6551

Product(s) Described:
O.06: Cryogenic Heat Pipe
O.07: HA4 Heat Pipe Cold Plate
O.08: Lightweight Ammonia Heat Pipe

TiNi Alloy Company
1144 65th Street, Suite A
Oakland, CA 94608

TiNi Alloy Company performs research and development in the area of shape-memory metals.

Contact: A. David Johnson
510-658-3172

Product(s) Described:
A.06: Digital Storage Device Prototype

Turbulence Prediction Systems

3131 Indian Road
Boulder, CO 80301

Turbulence Prediction Systems is engaged in the design, development, and manufacturing of instruments including, but not limited to, infrared devices.

Contact: H. Patrick Adamson
303-443-8157

Product(s) Described:

S.08: Advance Warning Airborne System

Umpqua Research Company

P. O. Box 791
Myrtle Creek, OR 97457

Umpqua Research Company focuses on research, development, and manufacture of water purification and water quality monitor support hardware, and analytical testing.

Contact: Clifford J. Jolly
503-863-5201

Product(s) Described:

S.09: Thermally Desorbable Toxin and Odor Control Cartridge

T.03: Catalytic Oxidizer for Treatment of Aqueous Wastes

T.04: Electrochemical Water Treatment Device and Process

T.05: Enzyme-Based Heterogeneous Oxidation Catalyst

T.06: Flow-Through Device for Acid Gas Removal from Aqueous Solution

T.07: Immobilized Urease Catalyst, Urea and Nitrogen Removal Cartridges

T.08: Regenerable Microbial Check Valve

ViGYAN, Inc.

30 Research Drive
Hampton, VA 23666-1325

ViGYAN performs aerospace research and development.

Contact: Sudhir C. Mehrotra
804-865-1400

Product(s) Described:

B.09: VPLOT3D

B.10: VGRID3D

S.10: Pilot Weather Advisor

Addendum

AOTF Technology, Inc.

640 Weddell Drive, #6
Sunnyvale, CA 94089

Design and manufacture of AOTFs (acousto-optic tunable filter). These are tunable optics filters that have no moving parts.

Contact: Patrick Katzka or Crista vanSandwijk
408-734-5435

Product(s) Described:

H.11: Acousto-Optic Tunable Filters

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 F.03: JF-4 Integrating Cryogenic Amplifier
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T.04: Electrochemical Water Treatment Device and Process
T.05: Enzyme-Based Heterogeneous Oxidation Catalyst
T.06: Flow-Through Device for Acid Removal from Aqueous Solution
T.07: Immobilized Urease Catalyst, Urea and Nitrogen Removal Cartridges
T.08: Regenerable Microbial Check Valve
V.03: Active Magnetic Micro-Gravity Isolator for Space Station

Index of Products by NASA SBIR Solicitation Topic

This section lists the products according to the technical topics contained in NASA's annual program solicitation. These topics serve as the basis for requesting proposals that meet NASA's needs for research and development in aeronautics and space technology.

Topic 01: Aeronautical Propulsion and Power

H.05: Multimode Optical Switch and Control Unit
I.07: Titanium Fibers, Filaments, Strips, and Foils
N.01: Rayleigh Scattering Diagnostic for Density and Temperature Measurements
N.02: The Phase Doppler Particle Analyzer
N.04: Optical-Fiber Temperature Sensor

Topic 02: Aerodynamics and Acoustics

B.09: VPlot3D
B.10: VGRID3D
M.03: RotorCRAFT
M.04: Force and Moment Balance for Water Tunnels
M.05: Forebody Vortex Control
M.06: Burst Frequency Processor
N.03: PHLOW
N.07: The FDNS CFD Code

Topic 03: Aircraft Systems, Subsystems, and Operations

A.05: Program CC, Version 4
B.02: SDL CASE Tool
C.07: RT/Expert
J.06: EO-1500 Spectral Contents Analyzer
M.02: EHPIC Mod 2.0
S.08: Advance Warning Airborne System
S.10: Pilot Weather Advisor

Topic 04: Materials and Structures

I.01: Biaxially Oriented Liquid Crystal Polymer Film
I.02: Foster-Miller Polymer Reaction Monitor
I.03: Polyamide/Liquid-Crystal-Polymer Blend
I.04: Distributed Fiber-Optic Composite-Material Cure Monitoring and Control System
I.05: Tungsten and Molybdenum Alloys
I.08: Clean-Room Floor Tile Covering
J.02: Real-Time, Adaptive-Vision Welding Guidance System
J.03: Model 1000 Welding Controller
J.04: Ion-Beam-Assisted Deposition
K.01: High-Energy, Dual-Energy Computed Tomography Defector Package

K.02: QUEST Integrated Load-Frame and Computed-Tomography System
K.04: Dual-Beam Lens for Micro-NDE
K.06: Fast Atom Sample Tester (FAST™)

Topic 05: Teleoperators and Robotics

B.01: Neural Net Toolbox
B.03: MetaData
C.01: Reactive Planning for EVA retriever
C.02: Robotic Tactile Sensor System
C.04: CyberImage
C.05: Holotrack
C.06: Serpentine Truss Robot
C.09: Motion Planning Algorithms for Dexterous Manipulator
C.10: Odetics Dexterous Manipulator
C.11: Omni-Wrist
C.12: Dual-Axis, Digital Servo Controller
H.03: Eagle 3004 Vision System
K.08: Z Sensor
V.05: An Integrated Micro-Gyroscope

Topic 06: Computer Sciences and Applications

A.01: QASE®RT
A.02: Intelligent Computational Resource Management System
A.03: Spacecraft Supercomputer
A.06: Digital Storage Device Prototype
B.05: Neural Networks for Fault Monitoring
B.07: InQuisX
C.08: Ground Vehicle Manager's Associate
H.01: Solid State Laser Scanner
B.08: SOCIAL

Topic 07: Information Systems and Data Handling

B.06: Sentinel
D.01: Interferometric Satellite Tracking System
D.04: Adaptive Imager
H.10: Omniview
P.03: Domestic Stirling Cycle Refrigerator

Topic 08: Instrumentation and Sensors

- A.04: Magnetic Bearings for High-Performance Optical-Disk Buffer
- B.04: FDP 3100 Frequency Domain Processor
- D.02: Digital Image Profiler
- E.03: III-V Compound Epi-Wafers
- F.01: Auto-Cal Detector Calibration System
- F.02: Cryogenic TIA Input Stage
- F.03: JF-4 Integrating Cryogenic Amplifier
- H.02: Model 100 Profilometer
- H.08: Cobra 2000 Laser
- H.09: Yttrium-Aluminum-Garnet Laser Rods
- H.11: Acousto-Optic Tunable Filters
- I.06: CVD Silicon Carbide™
- J.01: DIFKIN, A Coupled-Mass Transport and Chemical Kinetics Code for CVD Modeling
- L.01: Miniature Materials Analysis X-Ray Laboratory
- L.04: Space Rated, Rugged, Compact Time-of-Flight Mass Spectrometer
- M.01: An Optical Angle-of-Attack Sensor
- P.01: Hellum Transfer Pump
- R.01: PNF-300 Profiling Natural Fluorometer
- R.02: MER-2020 Oceanographic Instrument
- R.03: AOCI
- S.02: Wildfire
- S.03: 200 MHz Surface Acoustic Wave Aerosol Particle and Chemical Vapor Sensor
- S.05: Space Particulate Imaging Measurement Sensor
- S.06: Cloud Top Radiometer

Topic 09: Spacecraft Systems and Subsystems

- C.03: Cybernet Force-Reflecting Handcontroller
- D.03: Real-Time Integrated GPS/INS Navigation and Attitude Determination Software
- O.01: High-Heat-Flux, Condensing Heat Exchanger
- O.02: High-Heat-Flux, Single-Phase Exchanger
- O.03: Nonazeotropic Heat Pump for Water Heating
- O.04: Nontoxic, Two-Phase, Heat Transport Fluid
- O.06: Cryogenic Heat Pipe
- O.07: HA4 Heat Pipe Cold Plate
- O.08: Lightweight Ammonia Heat Pipe
- P.04: Long Life Cryocoolers
- Q.01: Pyroelectric Converter
- Q.04: Chemical/Mechanical Heat Pump
- V.01: T-Reaction Wheel
- V.02: T-SCANWHEEL
- V.04: Superconducting Large-Angle Magnetic Suspension

Topic 10: Space Power

- E.02: Indium-Phosphide Epitaxial Wafers and Solar Cells
- Q.02: ReLi® Rechargeable Lithium Cells and Batteries
- Q.03: Composite-Matrix Regenerators for Stirling-Cycle Engines
- Q.05: Ultra-Lightweight, All-Metal Mirror Facet for a Solar-Dynamic Power System

Topic 11: Space Propulsion

- J.05: longuard® Surface Treatment
- N.06: Particle Tracking Computer Software
- P.02: Joule-Thomson Cryostat

Topic 12: Human Habitability and Biology in Space

- H.04: Alpha-Numeric Electrochromic Displays
- S.01: Atmospheric Trace Gas Fluxmeter
- S.09: Thermally Desorbable Toxin and Odor Control Cartridge
- T.01: Process-Control Water Quality Monitor
- T.02: Prototype Membrane-Based Wash-Water Recovery Unit
- T.03: Catalytic Oxidizer for Treatment of Aqueous Wastes
- T.04: Electrochemical Water Treatment Device and Process
- T.05: Enzyme-Based Heterogeneous Oxidation Catalyst
- T.06: Flow-Through Device for Acid Gas Removal from Aqueous Solution
- T.07: Immobilized Urease Catalyst, Urea and Nitrogen Removal Cartridges
- T.08: Regenerable Microbial Check Valve
- U.02: CDDP Non-Invasive Hemodynamic Patient Management System
- U.03: PaceMate
- U.04: Fiber-Optic pH Optrode and Electronics Interface
- U.05: Calorimeter and Waste Management System
- U.06: Variable-Speed Mid-Deck Centrifuge

Topic 13: Quality Assurance, Safety, and Check-Out for Ground and Space Organizations

E.01: ARACOR VLSI Qualification Test System
F.05: Wireless Headset Network
K.03: Instrumented Torque Wrench (INTOWS)
K.05: Dynamic Laser Speckle Profilometer
K.07: Thermoelectric Microprobe
O.05: SCAPE-Suit Heater
S.04: A Non-Optical, Real-Time Particle Fallout
Monitor
S.07: Raman Gas-Monitoring System

Topic 14: Satellite and Space Systems Communications

F.04: Automated Reliability Test Set for Electronic
Modules
G.01: Custom, Fully Monolithic GaAs Switch Matrix
Subsystems
G.02: Solid-State Active Ku-Band Antenna
H.06: Series 120 Diode-Pumped Solid-State Ring
Laser
H.07: Series 122 Diode-Pumped Solid-State Non-
Planar Ring Laser

Topic 15: Materials Processing, Micro- Gravity, and Commercial Applications in Space

L.02: Multi-Color Imaging Pyrometer
L.03: Optical Temperature Monitor
N.05: NEKTON® Fluid-Flow Numerical Simulator
U.01: FlurO₂
V.03: Active Magnetic Micro-Gravity Isolator for
Space Station

Index of Firms by State

Alabama

SECA, Inc.

Arizona

General Pneumatics Corporation, Western
Research Center
Infrared Laboratories, Inc.

California

Advanced Research and Applications
Corporation
Advanced Decision Systems
Aerometrics, Inc.
ANCO Engineers, Inc.
AOTF Technology, Inc.
Biospherical Instruments, Inc.
BoMed Medical Manufacturing, Ltd.
Chronos Research Labs, Inc.
Complee, Inc.
Eidetics International, Inc.
Energy Science Laboratories, Inc.
Femtometrics
Geoscience Limited
Integrated Systems, Inc.
International Technical Associates
ISX Corporation
Laser Power Corporation
Lightwave Electronics Corporation
Microwave Monolithics, Inc.
Netrologic, Inc.
Odetics, Inc.
Physical Research, Inc.
SKW Corporation
Space Instruments, Inc.
Systems Technology, Inc.
TINI Alloy Company

Colorado

Advanced System Technologies, Inc.
Turbulence Prediction Systems

Connecticut

Scientific Research Associates, Inc.
Springborn Laboratories, Inc.

Florida

Mainstream Engineering Corporation
Schwartz Electro-Optics, Inc.
Software Productivity Solutions, Inc.

Illinois

Bio-Imaging Research, Inc.

Massachusetts

Aerodyne Research, Inc.
Bauer Associates, Inc.
Cambridge Research & Instrumentation, Inc.

Charles River Analytics, Inc.
EIC Laboratories, Inc.
Foster-Miller, Inc.
Geo Centers, Inc.
I-Kinetics, Inc.
Mayflower Communications Company
Morton International
Physical Sciences Inc.
PSI Technology Company, Physical Sciences Inc.
Radiation Monitoring Devices, Inc.
Satcon Technology Corporation
Spectral Sciences, Inc.
Spire Corporation
Symbiotics, Inc.

Maryland

Omltron, Inc.

Michigan

Cybernet Systems Corporation
Daedalus Enterprises, Inc.

Minnesota

APA Optics, Inc.
Ross-Hime Designs, Inc.

Montana

Scientific Materials Corporation

North Carolina

McMahan Electro-Optics, Inc.

New Hampshire

Create, Inc.
Fluent Inc.

New Jersey

Continuum Dynamics, Inc.

New York

Conax Buffalo Corporation
Ithaco, Inc.
Macrodyne, Inc.
Metadyne, Inc.

Ohio

Ribbon Technology Corporation

Oregon

Bend Research, Inc.
Umpqua Research Company

Pennsylvania

Biochem Technology, Inc.
Micro-G Research, Inc.
Strainoptic Technologies, Inc.
Thermacore, Inc.

Tennessee

Accurate Automation Corporation
Mid-South Engineering, Inc.
QCI, Inc.
TeleRobotics International Inc.

Texas

Astro International Corporation
Computational Mechanics Company, Inc.
Schmidt Instruments, Inc.
Shason Microwave Corporation
Solar Kinetics, Inc.
Telenexus, Inc.
The Navtrol Company, Inc.

Utah

Bonneville Scientific, Ltd.

Virginia

Coleman Research Corporation
Interferometrics, Inc.
VIGYAN, Inc.

Washington

Stirling Technology Company